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Materiel Handling Accident Analysis

J. A. Piatt
J. C. Lavender
D. A. Seaver

April 1991

Prepared for
the U.S. Army Safety Center
Ft. Rucker, Alabama
under a Related Services Agreement
with the U.S. Department of Energy
Contract DE-AC06-76RLO 1830

Pacific Northwest Laboratory
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SUMMARY

Each year, the U.S. Army experiences over 2,000 materiel handling accidents. For the four-year period from FY 1983 to 1986, over 9,000 materiel handling accidents occurred with a total of almost 100,000 lost workdays and a total direct cost to the Army of almost 19 million dollars in injuries and property damage (excluding accidents of conventional motor vehicles involved in materiel handling).

The purpose of this study was to analyze Army materiel handling accident data to identify the causes and system inadequacies that lead to such accidents; to perform a field study to verify the accident causes and system inadequacies noted; and to develop recommendations to reduce the incidence and severity of material handling accidents.

Manual materiel handling accounts for the majority of the cases reported as materiel handling accidents with approximately a third of these being back injuries. During the four-year study period noted above, Army civilians had four times the materiel handling incidence rate of that for military personnel. Specific jobs and specific work locations have higher materiel handling accident incidence rates. The organizations with the highest military incidence rates were HQDA, AMC and USAEUR; those with the highest civilian incidence rates were HQDA, AMC and the Army National Guard. The overall Army materiel handling accident incidence rate was 0.202 accidents per 100 staff years, which is an order of magnitude less than some of the organizations with the highest rates.

In FY 1986, more detailed reporting was required for serious accidents (accidents which resulted in 20 or more lost workdays or $1,000 or more property damage). Over 70 percent of these serious materiel handling accidents were reported to be caused by handling excessive loads or using improper lifting techniques. Excessive loads and congested work areas were the problem areas reported most frequently during the field verification study. Personal factors such as inattention and overconfidence were reported as the most frequent system inadequacies in accident reports while the availability and adequacy of materiel handling equipment, and insufficient personnel were reported most frequently during the field verification study.

The field verification study provided an opportunity to examine the materiel handling from a systems perspective and develop recommendations which address many facets of the materiel handling accident problem: medical screening for positions with significant lifting requirements; guidance for manual materiel handling; materiel handling training; engineering controls; materiel handling equipment availability and maintenance; guidelines for design of Army systems; planning and scheduling of materiel handling operations; feedback from materiel handlers; incentives for injury prevention; compensation systems as a disability incentive; better reporting of materiel handling

accidents and costs; use of multiple activity categories in accident reporting for a more complete accounting of materiel handling accidents; and use of accident incidence rates in setting priorities for materiel handling countermeasures. The objective of these materiel handling recommendations is to reduce not only the direct losses and compensation costs, but to also increase the Army's overall state of readiness by reducing lost time due to materiel handling accidents.

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1.0 INTRODUCTION

Safety goals set by the President, Secretary of Defense and the Secretary of the Army require a three percent reduction in civilian and military injuries each year for the five-year period FY 1984-1988. The Army has failed to meet this goal in each year. One reason for the failure is the large number of materiel handling accidents. Materiel handling accidents are defined as those accidents that occur when the primary activity at the time of the accident is materiel handling. During the four-year period, FY 1983-1986, 9,183 materiel handling accidents occurred resulting in 9,226 injuries, 99,592 days lost and a total cost of $18,849,955. This includes accidents, injuries and the associated costs to Army civilian and military personnel. During the two-year period, Fiscal Years 1987 and 1988, there were 1,090 materiel handling accidents involving military personnel. These accidents resulted in 1,103 injuries, 11,656 days lost and $3,623,706 total costs. Figure 1.1 graphically depicts the magnitude of this problem (number of accidents and in dollars) for the four-year period. Figure 1.2 shows the numbers of the injuries and days lost with respect to the number of accidents. Figure 1.3 shows graphically accidents and total costs for the six-year period, FY 1983-1988 for military personnel only. (In 1987, a different system was implemented for tracking Army civilian accidents.)

The magnitude of these accidents and their days lost represent a significant impact on the resources of the Army. The knowledge gained by identifying the causes of these accidents and the implementation of preventive measures can reduce the number of accidents, increasing the available manpower resources. This will result in cost savings as well as increased military readiness.

To achieve the previously unachieved safety goals, the U.S. Army Safety Center (USASC) has implemented the Army Safety Studies Program (ASSP). This program focuses on Army safety at three levels:

- reducing specific types of accidents,
- enhancing Army systems affecting safety, and
- improving supporting databases and analysis methods.

As part of the focus on reducing specific types of accidents, serious materiel handling accidents were targeted for in-depth investigation and reporting for a one-year period. These accidents were investigated to identify the causes, the system inadequacies in the Army system, and the needed corrective measures. This information was developed by Army safety professionals, and reported on DA Form 285-1 in addition to the usual DA Form 285 report. These data have now been analyzed and are reported here. Subsequent efforts will verify the results reported here based on these data by field visits to review the actual operations and will develop specific recommendations targeted to each level of command for corrective actions.

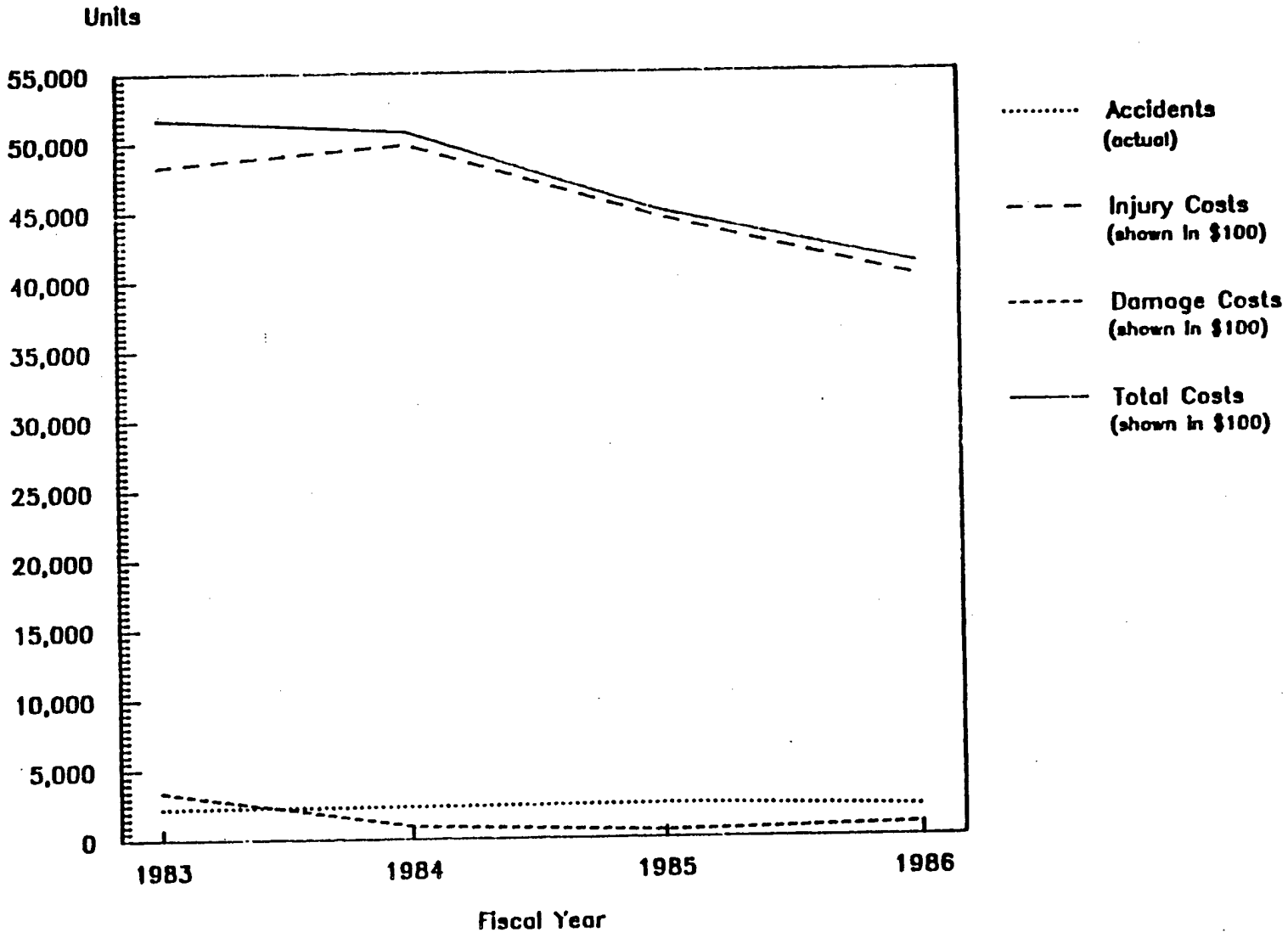


FIGURE 1.1. Summary of Accidents and Costs for All Personnel Classifications For the Four-Year period, FY 1983-1986

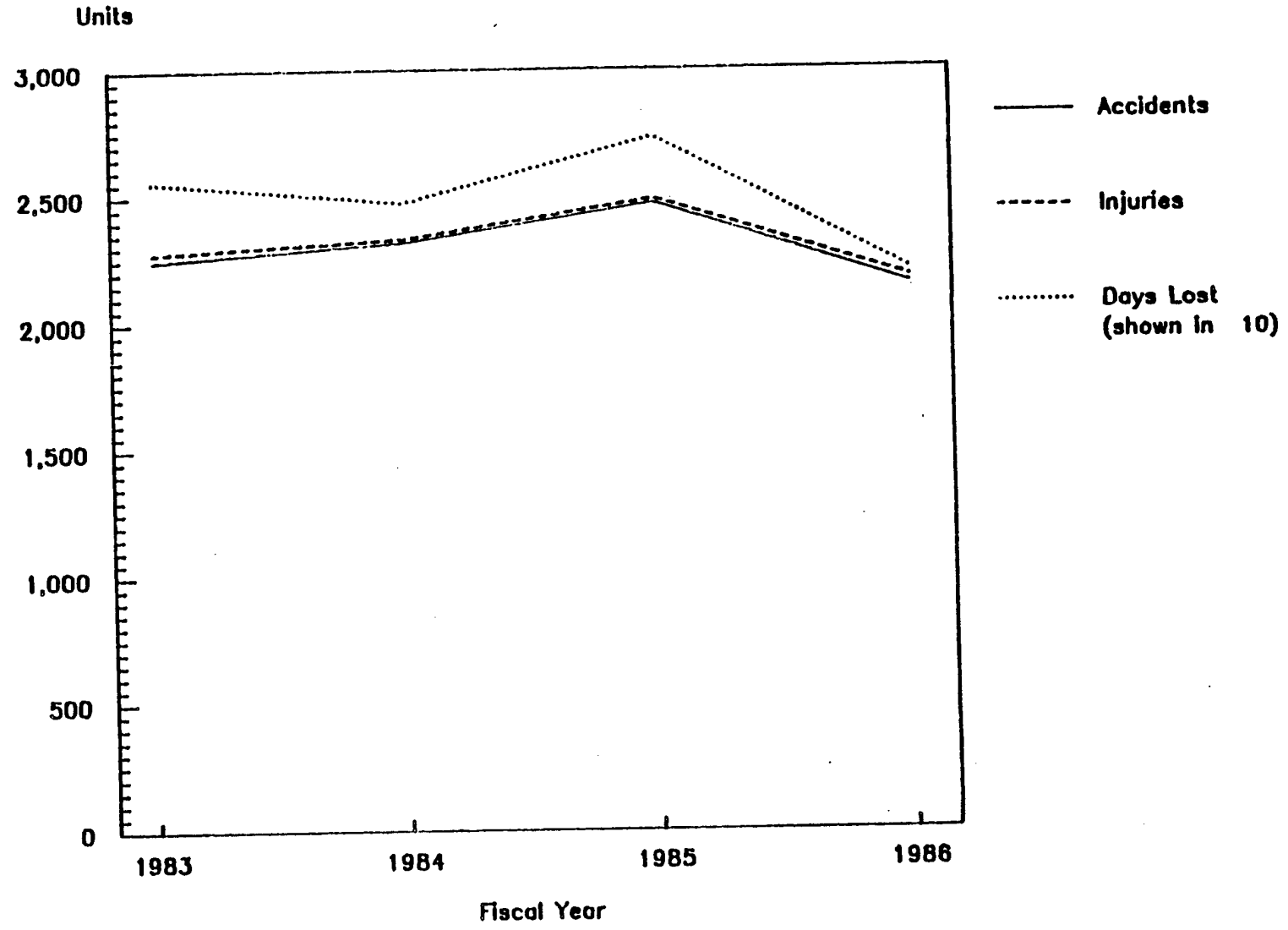


FIGURE 1.2. Summary of Days Lost, Injuries, and Accidents for All Classifications for the Four-Year Period, FY 1983-1986

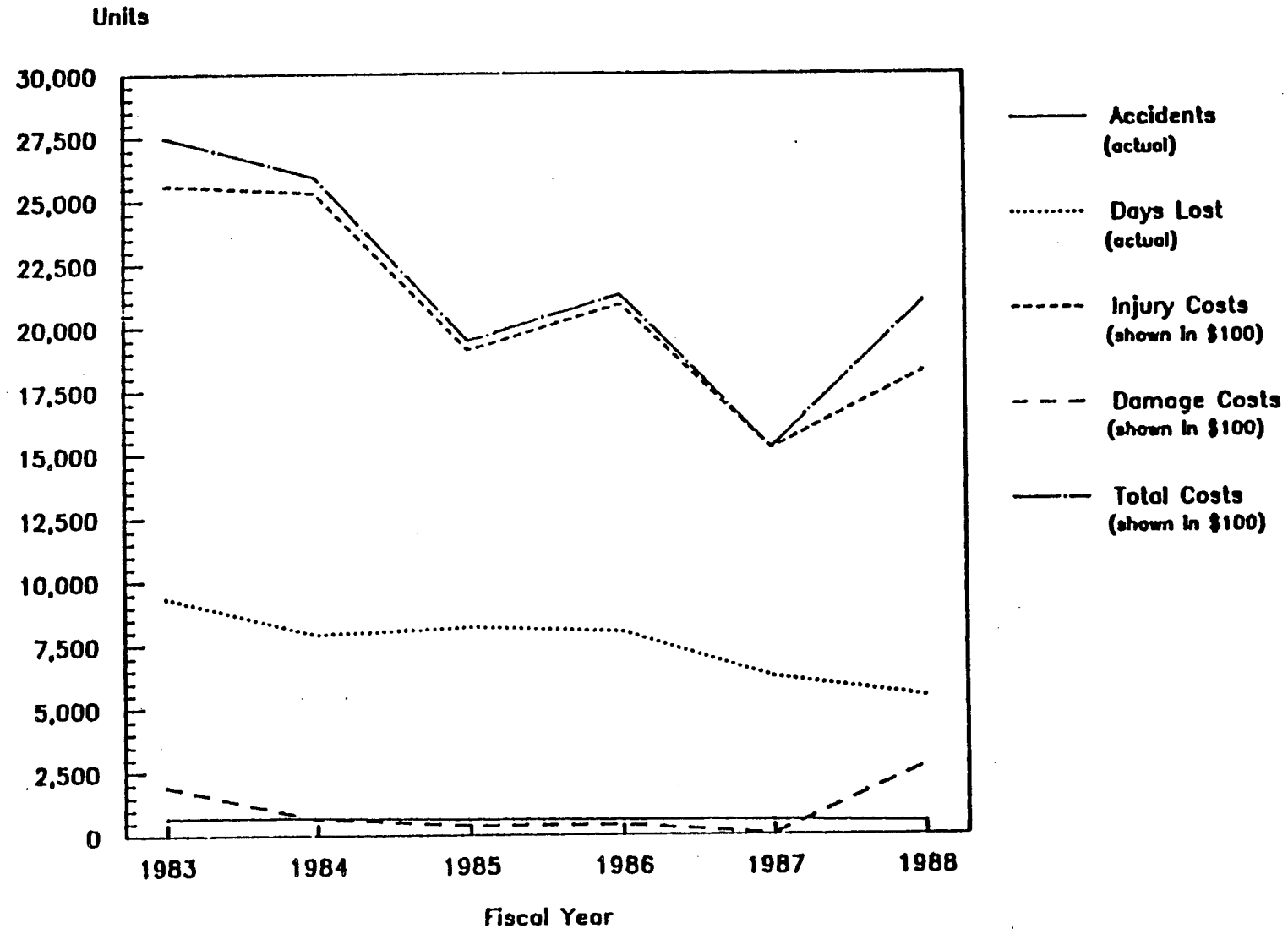


FIGURE 1.3. Summary of Accidents by Year for Military Personnel Only for the Six-Year Period, FY 1983-1988

2.0 METHODOLOGY

The analysis methodology for investigation of materiel handling accidents seeks to identify systemic problems that lead to accidents. It is based on the "3W" approach to accident investigation and prevention developed by the USASC:

- What happened? - categorized into human error, materiel failure, and environmental factors
- What caused it? - identification of the basic Army system inadequacy causing the accident
- What to do about it? - development of specific remedial measures targeted at specific command levels.

This report addresses the first two W's; and a subsequent section of the final report will recommend "What to do about it."

Materiel handling, as defined by the USASC, is any activity associated with the transportation, distribution and storage of materiel or passengers. Materiel handling accidents were further defined to include only those accidents, involving any person handling materiels, that occurred when materiel handling was determined to be the primary activity at the time of the accident. An accident is not considered a materiel handling accident if the accident was the direct result of some activity other than materiel handling.

For analysis purposes, materiel handling accidents were divided into three categories. This will provide a division of the data that can be used to compare the DA Form 285-1 data to the DA Form 285 data. It will also be useful when developing and conducting the field verification. The three categories are described below:

Transportation - This category includes accidents that occur during transportation activities including transporting, moving and delivering materiel or personnel. This does not include motor vehicle accidents that occur during materiel handling. These accidents are considered elsewhere in the Army Safety Center reporting system.

Loading or Unloading - This category includes accidents that have occurred during loading and unloading activities. These activities can occur either at fixed facilities (i.e., warehouses) or away from fixed facilities (i.e., transport or delivery vehicles).

Other Materiel Handling - This category includes accidents that can not be attributed to transportation or loading and unloading activities. Such as, Inventorying; Packing; Palletizing; Rigging; Withdrawing; and Marking. There is also an insufficient number of accidents or information for each of the materiel handling activities represented in this category to make accurate accident and injury projections.

Data from two sources were analyzed: 1) Department of Army Form 285 (DA Form 285), and 2) in-depth accident reports or Department of Army Form 285-1 (DA Form 285-1). The DA Form 285 is normally used by the commander or direct supervisor to record detailed information regarding the accident. That is, the individual responsible, the operation or activity at the time of the accident, and any people and/or materiel involved. These data are normally reported for all accidents classified A, B, or C, and certain class D accidents. They are sent to the USASC, coded, and entered into the Army Safety Management Information System (ASMIS) database. This system was accessed to identify and examine information about materiel handling accidents. The ASMIS database contains 9,217 materiel handling accident reports (Army and civilian personnel) for the four-year period FY 1983-1986 and 1,090 materiel handling accident reports (Army personnel only) for the period FY 1987-1988.

DA Form 285-1 reports were required in 1986 for the more serious materiel handling accidents specifically to address systemic causes of materiel handling accidents. The more serious materiel handling accidents were identified based on the following criteria, 1) the most serious injury resulted in 20 or more lost workdays and/or 2) damage to Army property was greater than or equal to $1,000. Individual investigations were conducted by trained safety professionals and thus provided information more directly focused on systemic problems than the more general data contained in the DA Form 285. Reports were received on 165 of these targeted accidents. All of these in-depth accident reports involved materiel handling, i.e., there were no reports received that involved handling personnel.

The primary focus of the analysis was the in-depth accident reports provided by the specific data collection effort and reported in DA Form 285-1. This narrative data focused on the materiel handling aspects of the accident. Each narrative was individually examined by an analyst experienced in evaluation of narrative accident data.

A number of problem areas were identified in the initial review of the narratives. Once the problem areas were identified, the system inadequacies, as identified by trained safety professionals as the cause of the accident, were tabulated for each problem area. Each record and its associated problem area and system inadequacies were assigned to a category (i.e., Transportation, Loading or Unloading or Other Categories) based on the primary materiel handling activity at the time of the accident.

Based upon the problem area findings discussed above, projections were made, for each materiel handling category, of the impacts of each of these problem areas for a four-year period (FY 1983-1986). The projections made

are based on Army system inadequacies or human errors, i.e., does not include materiel failures or environment. Numbers of accidents, injuries, work days lost, and costs were projected for each problem area by first determining the relative numbers of accidents in the sample of DA Form 285-1 data collected for the project, in the ASMIS data base for 1986, and the ASMIS data base for FY 1983-1986. For example, there were 77 transportation accidents with DA Form 285-1 reports, 1,139 shown in the ASMIS database for 1986, and 4,444 shown for FY 1983-1986. The accidents in the DA Form 285-1 thus represent seven percent of the transportation accidents for 1986 and 2 percent for the four-year period.

This percentage was then used to calculate expected numbers of accidents, injuries, days lost, and costs for 1986 and FY 1983-1986 using the reciprocal of the above percentages (representing the ratio of the number accidents in the two data pools). Using the example problem area, "Improper Techniques," for the transportation category, the projected number of accidents due to "Improper Techniques" are 503 for FY 1986 and 1,962 for the four-year period FY 1983-1986.

Additional analyses were performed using the DA Form 285 data contained in the ASMIS database. One of the analyses was performed to identify the Military Occupational Specialties (MOS) most often involved in a materiel handling accident. Another analysis, also using the ASMIS database, was performed to determine the accident levels for the Major Army Commands (MACOM). A third analysis was performed to identify where the accidents typically occur. Special analyses of the MOS's, MACOM's and accident locations were also performed on FY 1987 and 1988 data. Beginning in 1987, materiel handling accidents for Army civilian and non-military personnel were reported and processed through another system. Thus, only data on military accidents were analyzed for these two years.

A final analysis was performed to verify and validate the results of the DA Form 285-1 accident analysis. This involved selecting a sample of materiel handling accidents from the ASMIS database (i.e., DA Form 285 accident data), stratified by materiel handling category for the FY 1983-1986 period. A sample data base was developed containing roughly the same number of accidents for each year as were used in the original analysis. The accident narrative data in the sample data base were reviewed to determine the frequency of occurrences for each problem area. These frequencies were then compared to the results of the original analysis for verification and validation.

3.0 FINDINGS

During the four-year period 9,183 accidents occurred when materiel handling was the primary activity at the time of the accident. The data for the four-year period by materiel handling category and fiscal year are shown in Table 3.1. There were a total of 9,226 injuries with a total time lost of 99,592 days and a total cost of $18,849,955.

Four-year totals of the materiel handling accident data are provided in Table 3.2. From Table 3.2, transportation accounted for approximately 48 percent of all the materiel handling accidents, or 4,444 of the 9,183 accidents. Transportation also accounted for 48 percent of the injuries or 4,458 of the 9,226 injuries. Unloading accounted for 33 percent of the accidents and injuries, or 3,060 of the 9,183 accidents and 3,071 of the 9,226 injuries. The remaining 1,679 (19 percent) accidents and 1,697 (19 percent) injuries were assigned to the category called, "Other Materiel Handling."

The 9,183 accidents resulted in $18,279,260 injury costs and $570,695 damage costs, for a total of $18,849,955 (see Table 3.2). Transportation accidents represented about 46 percent of the injury costs or $8,405,205. Of the total $570,695 in damage costs, transportation accounted for $65,152, or approximately 11 percent. Unloading activities accounted for about 33 percent, or $6,019,986 of the injury costs and $298,257 of the damage costs or about 52 percent. The accidents identified in the other category accounted for approximately 21 percent of the total injury costs and 36 percent of the damage costs or $3,854,069 and $207,286, respectively.

The following sections describe the problem areas associated with the three categories described previously. These problem areas were identified during the review of the DA Form 285-1 in-depth accident reports. Each problem area begins with a summary of the accident statistics based on the analysis of the in-depth accident reports and a projection of the accident statistics for the targeted year (FY 1986) and for the four-year period, FY 1983-1986.

3.1 TRANSPORTING, MOVING, OR DELIVERING

This category includes accidents that occur during transportation activities including transporting, moving and delivering materiel or personnel. There were 77 accidents, of which 76, attributable to human errors or Army system inadequacies, were examined. These activities can occur either at fixed facilities (i.e., warehouses, etc.,) or away from fixed facilities (i.e., temporary storage facilities, transfer points, etc.,). This does not include motor vehicle accidents that occur during materiel handling. These accidents are considered elsewhere in the Army Safety Center reporting system.

TABLE 3.1. Summary of Materiel Handling Accident Data for the Four-Year Period FY 1983-1986

	Transportation		Unloading		Other Materiel Handling		Annual
	Civilian	Military	Civilian	Military	Civilian	Military	Totals
			1983				
Accidents	716	254	508	325	317	127	2,247
Injuries	718	255	510	328	319	135	2,265
Days lost	7,903	3,006	5,000	4,678	3,318	1,656	25,561
Injury Costs	$1,114,300	$747,750	$581,625	$956,045	$577,100	$854,845	$4,831,665
Damage Costs	3,125	2,746	142,974	111,200	1,447	76,821	338,313
Total Costs	$1,117,425	$750,496	$724,599	$1,067,245	$578,547	$931,666	$5,169,978
			1984				
Accidents	846	282	466	298	324	102	2,318
Injuries	846	283	468	299	324	103	2,323
Days lost	8,720	3,514	4,820	3,442	3,266	952	24,714
Injury Costs	$1,374,590	$1,259,735	$591,431	$793,980	$488,319	$474,230	$4,982,285
Damage Costs	3,035	14,079	23,736	6,643	1,200	41,875	90,568
Total Costs	$1,377,625	$1,273,814	$615,167	$800,623	$489,519	$516,105	$5,072,853
			1985				
Accidents	975	232	515	311	356	81	2,470
Injuries	977	234	515	311	360	83	2,480
Days lost	10,005	2,469	4,933	4,502	4,149	1,225	27,283
Injury Costs	$1,344,600	$638,040	$611,200	$1,044,200	$586,025	$227,000	$4,451,065
Damage Costs	1,104	7,000	0	6,805	9,897	23,268	48,074
Total Costs	$1,345,704	$645,040	$611,200	$1,051,005	$595,922	$250,268	$4,499,139
			1986				
Accidents	889	250	355	282	305	67	2,148
Injuries	890	255	357	283	305	68	2,158
Days lost	8,100	2,557	3,595	4,536	2,344	902	22,034
Injury Costs	$1,167,400	$758,790	$428,050	$1,013,455	$330,675	$315,875	$4,014,245
Damage Costs	1,320	32,743	1,716	5,183	51,578	1,200	93,740
Total Costs	$1,168,720	$791,533	$429,766	$1,018,638	$382,253	$317,075	$4,107,985

TABLE 3.2. Summary of Materiel Handling Accident Data by Category for the Four-Year Period FY 1983-1986

	Transportation		Unloading		Other Materiel Handling		Four Year
	Civilian	Military	Civilian	Military	Civilian	Military	Totals
Accidents	3,426	1,018	1,844	1,216	1,302	377	9,183
Injuries	3,431	1,027	1,850	1,221	1,308	389	9,226
Days Lost	34,728	11,546	18,348	17,158	13,077	4,735	99,592
Injury Costs	$5,000,890	$3,404,315	$2,212,306	$3,807,680	$1,982,119	$1,871,950	$18,279,260
Damage Costs	8,584	56,568	168,426	129,831	64,122	143,164	570,695
Total Costs	$5,009,474	$3,460,883	$2,380,732	$3,937,511	$2,046,241	$2,015,114	$18,849,955

3.1.1 Handling Excessive Loads

This problem area includes handling excessive loads either in a vertical or horizontal plane. Loads may be excessive either in weight or size. Loads are excessive when the weight or size of the object is too great for the manpower resources applied to the task, whether that task is performed by an individual or a group. Procedures were not violated or were not indicated as being violated. These accidents were selected by reviewing the task error, the system inadequacy, and the recommended actions to determine if the load was in excess of the handlers capabilities.

The excessive load problem area includes two categories of materiel handlers. The two categories are Team and Individual. These categories were noted during the analysis of the in-depth reports and indicate that during unloading operations team and individual materiel handling accounted for 28 and 72 percent, respectively, of the "Handling Excessive Loads" Problem Area accidents. The in-depth reports include that, in approximately 65 percent of the individual activities and in 83 percent of the team activities, additional resources, either manpower or mechanical, should have been utilized.

These categories have also been divided further to indicate if the accident occurred during lifting, carrying or lateral (push/pull) operations. These subcategories are defined as follows:

a. Lift: Lifting loads or bulky packages that are in excess of the materiel handler's capabilities.

b. Carry: Carrying loads or bulky packages that are in excess of the materiel handler's capabilities, or over too great a distance.

c. Lateral Movement: Pushing or pulling carts or equipment on casters that exceed the materiel handlers capabilities.

Hazards: This problem area presents potential hazards to individuals or teams when the lifting, carrying, or lateral movement of objects is attempted without the application of adequate manpower resources, i.e., the load is in excess of the handler's capabilities. Injuries to back (strains, etc.,), neck, abdominal (hernias) or limb areas and dropped loads are common to this type of hazard.

3.1.1.1 Individual Activities

Individual activities, discussed in the following, include those accidents identified in the in-depth reports that were being performed by one individual at the time of the accident.

3.1.1.1.1 Lift (22)

	DA Form 285-1 Data (n=76)	Estimated for 1986 (n=1,139)	Estimated for 1983-1987 (n=4,444)
Accidents	22	330	1,286
Injuries	22	330	1,286
Days Lost	792	11,870	46,311
Injury Cost	151,215	2,266,235	8,842,098
Total Cost	$151,215	$2,266,235	$8,842,098

Description: The handler used proper procedures or a procedural violation was not identified while lifting. However, the object being lifted was bulky or in excess of his/her capabilities.

Causes:

1. Overconfidence (22%)

Example: Active Army soldier ruptured an aural tube in his ear because he was overconfident in his ability to lift a load in excess of his capabilities. The soldier held his breath while lifting truck hubs, he did not know that this would exert excessive pressure on his aural tube.

2. Inadequate Direct Supervision by Direct Supervisor (17%)

Example: An Army civilian injured his back when lifting a cylinder head due to inadequate direct supervision. His shop foreman had not attempted to correct his poor lifting methods.

3. Inadequate Unit Training (13%)

Example: A civilian failed to use a ladder when lifting a case of paint and pulled a shoulder muscle. Because of inadequate training, the employee failed to use a ladder to place himself in a proper lifting position.

4. Inadequate Attention (9%)

Example: An Army civilian employee was not paying adequate attention and injured his back when lifting a 40-pound load.

5. Inadequate Written Procedures (9%)

Example: An Army civilian employee injured his back when unloading (lifting) tents that were in excess of his capabilities. The employee did not seek assistance because the written procedures were inadequate for normal operations.

6. Inadequate Experience (4%)

Example: Because of his lack of experience, a National Guard technician failed to seek assistance when moving a box weighing approximately 50 pounds. The technician was not experienced in proper lifting procedures.

7. Insufficient Information (26%)

There was sufficient information to determine the problem area; however, insufficient information was provided in the DA Form 285-1 to determine the system inadequacy.

3.1.1.1.2 Carry (4)

	DA Form 285-1 Data (n=76)	Estimated for 1986 (n=1,139)	Estimated for 1983-1987 (n=4,444)
Accidents	4	60	234
Injuries	4	60	234
Days Lost	147	2,203	8,596
Injury Cost	20,025	300,112	1,170,936
Total Cost	$20,025	$300,112	$1,170,936

Description: The handler used proper procedures or a procedural violation was not identified while carrying objects. However, the object being carried was bulky or weighed in excess of the employees capabilities or the distance was too great.

Causes:

1. Inadequate Attention (25%)

Example: A National guard soldier was inattentive while carrying a projectile. He dropped the projectile on his foot while transferring (carrying) it to a vehicle.

2. Inadequate Motivation (25%)

Example: A foreign national employee was carrying a fence post in excess of his capabilities when it slipped out of his hand. He ruptured a tendon in his finger when he attemted to catch it. He was inadequately motivated and failed to assess the problem properly.

3. Inadequate Unit Training (25%)

Example: A non-appropriated fund employee was carrying an 80 pound-box of lead and injured his back. He had not been adequately trained in safe lifting and carry methods.

5. Insufficient Information (25%)

There was sufficient information to determine the problem area; however, insufficient information was provided in the DA Form 285-1 to determine the system inadequacy.

3.1.1.1.3 Lateral Movement (2)

	DA Form 285-1 Data (n=76)	Estimated for 1986 (n=1,139)	Estimated for 1983-1987 (n=4,444)
Accidents	2	30	117
Injuries	2	30	117
Days Lost	108	1,619	6,315
Injury Cost	13,875	207,942	811,322
Total Cost	$13,875	$207,942	$811,322

Description: The handler used proper procedures or a procedural violation was not identified while pushing or pulling objects. However, the object being pushed or pulled weighed in excess of the employees capabilities.

Causes:

1. Overconfidence (50%)

Example: Employee was over-confident is his ability to reposition a conveyor section on a forklift. The employee felt he could safely move the section because of his overconfidence.

5. Insufficient Information (50%)

There was sufficient information to determine the problem area; however, insufficient information was provided in the DA Form 285-1 to determine the system inadequacy.

3.1.1.2 Team Activities

Team activities include those accidents identified in the in-depth reports that were being performed by a team at the time of the accident. This includes accidents that were the result of a team of materiel handlers lifting in excess of their capabilities. All accidents identified in the in-depth reports for team activities involved lifting.

3.1.1.2.1 Lift (5)

	DA Form 285-1 Data (n=76)	Estimated for 1986 (n=1,139)	Estimated for 1983-1987 (n=4,444)
Accidents	5	75	292
Injuries	5	75	292
Days Lost	246	3,687	14,385
Injury Cost	37,800	566,503	2,210,305
Total Cost	$37,800	$566,503	$2,210,305

Description: Teams used proper procedures or a procedural violation was not identified while lifting objects. However, the object being lifted was bulky or weighed in excess of the capabilities of the team.

Causes:

1. Overconfidence in Self (40%)

Example: Two employees were lifting sheet metal from the back of a truck when one piece slipped and one of the employees injured his back moving out of the way. The employee overexerted himself because he was overconfident in his ability to lift the sheet metal.

5. Inadequate motivation (20%)

Example: An active duty soldier made the wrong decision to have his squad move a railroad rail without the assistance of a forklift. Because of haste (inadequate motivation), a forklift was not requested to assist in the move and the rail was dropped breaking his leg.

6. Insufficient Information (40%)

There was sufficient information to determine the problem area; however, insufficient information was provided in the DA Form 285-1 to determine the system inadequacy.

3.1.2 Improper Techniques

This category includes actions where the handler failed to use proper procedures while lifting, carrying or moving objects. This category is concerned with the proper use of body techniques in accordance with DOD 4145.19-R-1 and the adherence to standard operating procedures (SOPs) when handling materiels. That is, failing to bend at the knees when lifting or handling materiels not in excess of procedural limits. The accidents identified as "Improper Techniques" were further substantiated by reviews of the system inadequacies and the recommended actions. The Improper Techniques Problem Area is divided into three subcategories:

a. Lift: Poor lifting techniques, such as failure to bend at the knees and reaching too far to grasp a load.

b. Carry: Poor carrying techniques, such as carrying objects improperly, or over too great a distance.

c. Lateral Movement: Improper push/pull technique.

Hazards: This problem area presents potential hazards to individuals when attempting to lift, carry or move objects without applying the proper procedures. Team members must continuously be aware of the potential danger of materiel handling functions. Failure to scope the task, and evaluate and apply proper techniques cause most injuries in this category. Injuries to back (strains, etc.,), neck, abdominal (hernias) or limb areas are common to this type of hazard.

3.1.2.1 Lift (24)

	DA Form 285-1 Data (n=76)	Estimated for 1986 (n=1,139)	Estimated for 1983-1987 (n=4,444)
Accidents	24	360	1,403
Injuries	24	360	1,403
Days Lost	910	13,638	53,211
Injury Cost	113,365	1,698,983	6,628,869
Total Cost	$113,365	$1,698,983	$6,628,869

Description: The handler failed to use proper procedures while lifting objects. This includes failure to bend at the knees when lifting or lifting loads in excess of procedural limits. This category is concerned with the proper use of body techniques in accordance with DOD 4145.19-R-1 Chapter 6.

Causes:

1. Overconfidence (24%)

Example: An active duty soldier was lifting heavy tarpaulins without assistance and injured his lower back. He was overconfident in his abilities and failed to seek assistance. Refer to DOD 4145.19-R-1, Chapter 6, Paragraph 6-114.

2. Inadequate Attention (19%)

Example: An Army civilian employee improperly lifted an aircraft weighing kit and injured his elbow. Because the employee was inattentive, he failed to follow local policy and lifted kit abruptly from the floor.

3. Habit Interference (11%)

Example: An employee made an improper simple physical action, lifting. Because of habit interference, he had repeatedly lifted 50-pound boxes of fuses impoperly. Repeating this operation resulted in a strain of the lower abdominal muscles.

4. Inadequate Direct Supervision by Direct Supervisor (8%)

Example: A National Guard soldier was in violation of a local Standard Operating Procedure (SOP) when he lifted a tool bin without assistance. The maintenance supervisor allowed the technician to lift the container (inadequate direct supervision).

5. Inadequate Unit Training (8%)

Example: An employee sustained a hernia to his abdominal area when improperly performing a simple physical action, lifting a latrine. Training received by the employee did not adequately address safe lifting and carrying methods.

6. Inadequate Motivation (8%)

Example: A National Guard soldier failed to follow general safety rules and did not seek assistance when lifting a piece of lumber. He was unable to maintain his grip. The employee cut his thumb because of inadequate motivation, he acted hastily.

7. Insufficient Information (22%)

There was sufficient information to determine the problem area; however, insufficient information was provided in the DA Form 285-1 to determine the system inadequacy.

3.1.2.2 Lateral Movement (6)

	DA Form 285-1 Data (n=76)	Estimated for 1986 (n=1,139)	Estimated for 1983-1987 (n=4,444)
Accidents	6	90	351
Injuries	6	90	351
Days Lost	225	3,372	13,157
Injury Cost	24,700	370,175	1,444,300
Total Cost	$24,700	$370,175	$1,444,300

Description: The handler failed to use proper procedures while pushing or pulling objects. This category is concerned with the proper use of body techniques in accordance with DOD 4145.19-R-1, Chapter 6.

Causes:

1. Inadequate Experience (33%)

Example: A temporary employee was unloading, lifting and pulling, (complex physical action) sleeping bags improperly. The employee was not experienced and failed to follow the SOP and use a hand cart.

2. Overconfidence in Self (17%)

Example: Employee misjudged the weight of a conveyor section and was over confident is his ability to lift the conveyor section. The employee performed a simple physical action contrary to procedures. See DOD 4145. 19-R-1, Chapter 6, Paragraph 6-114.

3. Inadequate Direct Supervision (17%)

Example: An Army civilian employee was moving a 380 pound teletypewriter when she injured her back. She was allowed to move the printer by herself because of inadequate direct supervision.

4. Insufficient Information (33%)

There was sufficient information to determine the problem area; however, insufficient information was provided in the DA Form 285-1 to determine the system inadequacy.

3.1.2.3 Carrying (3)

	DA Form 285-1 Data (n=76)	Estimated for 1986 (n=1,139)	Estimated for 1983-1987 (n=4,444)
Accidents	3	45	175
Injuries	3	45	175
Days Lost	96	1,439	5,613
Injury Cost	19,390	290,595	1,133,805
Total Cost	$19,390	$290,595	$1,133,805

Description: The handler failed to use proper procedures while carrying objects. This includes failing to keep packages close to the body or carrying packages over great distances. This category is concerned with the proper use of body techniques in accordance with DOD 4145.19-R-1, Chapter 6.

Causes:

1. Inadequate Motivation (40%)

Example: An Army civilian employee was inadequately motivated, i.e., he acted hastily when he carried a box of paper on his shoulders. See DA Pamphlet 385-8.

2. Inadequate Services (40%)

Example: An employee acted hastily and suffered a hernia carrying paper on his shoulder. He acted hastily because the copy room was out of copy paper (inadequate services).

4. Habit Interference (20%)

Example: An Army civilian employee was carrying an electric sewer auger down the stairs when he injured his lower back. Because of habit interference, he failed to seek assistance and suffered the injury. See DOD 4145. 19-R-1, Chapter 6, Paragraph 6-114.

3.1.3 Unsecured Loads (7)

	DA Form 285-1 Data (n=76)	Estimated for 1986 (n=1,139)	Estimated for 1983-1987 (n=4,444)
Accidents	7	105	409
Injuries	7	105	409
Days Lost	285	4,271	16,665
Injury Cost	35,700	535,030	2,087,511
Total Cost	$35,700	$535,030	$2,087,511

This category includes items that fall because they are unstable, tipped-over when contacted, or were dropped in the attempt to lift or carry, whether that attempt was made manually or by use of equipment. This category includes loads that shift during materiel handling, i.e., slid or fell during materiel transfers. The "Unsecured Loads" Problem Area also includes accidents caused by unsecured objects that fell or slid during materiel access or personnel movement, i.e., bumped into an object causing it to fall.

Hazards: This problem area presents potential hazards to individuals in the area near the falling objects, whether they are the handler or are bystanders in the vicinity of the activity. This problem area also has the potential for serious injury. Injury is often caused by the handler or other individuals trying to catch or stop the movement of the object. Serious injury, such as broken bones and severe cuts and bruises can result from these hazards.

Causes:

1. Inadequate Attention (29%)

Example: An Army civilian employee and his assistant did not expect the load on the pallet to shift. He was not aware of how other loads were stacked on the pallet (inadequate attention).

2. Inadequate Motivation/Mood (14%)

Example: A steel plate fell off a stack and broke the foot of a civilian employee. His attention was not focussed on the task at hand because he was in a hurry to complete the job (inadequate motivation).

3. Habit Interference (14%)

Example: A foreign national employee did not anticipate that a piece of lumber would fall from the stack when he removed another piece. He had performed this task before (habit interference) and had not been injured.

4. Inadequate Inspection (14%)

Example: A National Guards foot was broken when a canister fell off a stack. He failed to adequately inspect the canister stack when he removed the tarp, causing the canister to fall.

5. Insufficient Information (29%)

There was sufficient information to determine the problem area; however, insufficient information was provided in the DA Form 285-1 to determine the system inadequacy.

3.1.4 Singular Problem Areas (3)

This is a collection of accidents that appear to occur infrequently (i.e, one or two accidents in the in-depth reports) during transportation activities. There are insufficient data to project, with any degree of confidence, the future consequences of these problems. One of the accidents, Example 1, was the result of "Equipment Usage." Examples 2 and 3 are the result of "Trips, Slips or Falls."

1. Example 1 - Equipment Usage: A foreign National employee was assisting other employees using the wrong equipment when attempting to lift a wooden reel onto a revolving platform. The team was allowed to use the wrong equipment because of inadequate direct supervision. This accident resulted in 54 days lost and $12,150 in injury and total costs.

2. Example 2 - Trips, Slips or Falls: An Army civilian employee was carrying a box of potatoes when the ship rolled causing him to fall against a stove. The injury was the result of his failure to anticipate that the ship would roll on open sea. There was insufficient information to determine a system inadequacy. This accident resulted in 26 days lost and $2,600 in injury and total costs.

3. Example 3 - Trips, Slips or Falls: An Army civilian employee was carrying sewer cable to his truck and stepped into a hole, spraining his ankle. He was paying inadequate attention and did not see the hole. This accident resulted in 45 days lost and $4,500 in injury and total costs.

3.2 LOADING OR UNLOADING

This category includes accidents that have occurred during loading and unloading activities. These activities can occur either at fixed facilities (i.e., warehouses, etc.) or away from fixed facilities (i.e., transport or delivery vehicles, etc.). This does not include operations such as uploading ammunition into weapons systems. There were 63 accidents, of which 59, attributable to human errors or Army system inadequacies, were examined. The following is the analysis of the in-depth accident reports for the more serious materiel handling "Loading or Unloading" accidents.

3.2.1 Handling Excessive Loads

This problem area includes handling excessive loads either in a vertical or horizontal plane. Loads may be excessive either in weight or size. Loads are excessive when the weight or size of the object is too great for the manpower resources applied to the task, whether that task is performed by an individual or a group. These accidents were selected by reviewing the task error, the system inadequacy and the recommended actions to determine if the load was in excess of the handlers capabilities.

Hazards: This problem area presents potential hazards to individuals or teams when the lifting, carrying, or lateral movement of objects is attempted without the application of adequate manpower resources, i.e., the load is in excess of the handler's capabilities. Procedures were not violated or were not indicated as being violated. Injuries to back, neck, abdominal or limb areas are common to this type of hazard.

3.2.1.1 Individual Activities

Individual activities include those accidents identified in the in-depth reports that were being performed by one individual at the time of the accident.

3.2.1.1.1 Lift (13)

	DA Form 285-1 Data (n=59)	Estimated for 1986 (n=637)	Estimated for 1983-1987 (n=3,060)
Accidents	13	140	674
Injuries	13	140	674
Days Lost	792	8,551	41,077
Injury Cost	151,215	1,632,609	7,842,676
Total Cost	$151,215	$1,632,609	$7,842,676

Description: The handler used proper procedures or a procedural violation was not identified while lifting. However, the object being lifted was bulky or in excess of his/her capabilities.

Causes:

1. Overconfidence (38%)

Example: A National Guard soldier was unloading heavy packages from a truck without assistance. The soldier was confident in his ability to unload the truck; however, due to his overconfidence he sustained an inguinal hernia.

2. Inadequate Experience (14%)

Example: A National Guard technician was unloading tires from the back of truck and injured his back. His injury may have been caused by inadequate experience. That is, he had not lifted enough to realize that he should lift with his legs and not his back.

3. Inadequate Direct Supervision (6%)

Example: An Army civilian did not seek assistance when lifting steel cabinets from a truck and pulled a muscle in his back. He did not seek assistance or use a mechanical device because his supervisor had failed to instruct him in safe lifting procedures.

4. Inadequate Unit Training (6%)

Example: A Foreign National employee was allowed to lift kitchen equipment by himself because he had not received unit safety training. This lack of training allowed the employee to make an improper decision.

5. Inadequate Facilities or Services (6%)

Example: A National Guard soldier injured his back while lifting and stacking truck tires. There were not enough personnel (inadequate services) assigned to perform the task safely.

6. Improper Use of Tools or Equipment (6%)

Example: Employee failed to use the proper hand truck (improper use of equipment) when moving a file cabinet from one level to another. He overexerted himself when lifting the cabinet up the stairs.

7. Inadequate Motivation/Mood (3%)

Example: A National Guard soldier acted hastily (inadequate motivation) when unloading an AMV without assistance. Because he was in a hurry, he aggravated a pre-existing hernia.

8. Fatigue (3%)

Example: A National Guard Soldier misjudged the weight of a projectile and dropped it on his foot. He had been on duty for 19 hours.

9. Inadequate Attention (3%)

Example: A National Guard Soldier was inattentive and misjudged the weight of a projectile. He dropped the projectile on his foot.

10. Insufficient Information (15%)

There was sufficient information to determine the problem area; however, insufficient information was provided in the DA Form 285-1 to determine the system inadequacy.

3.2.1.1.2 Lateral Movement (2)

	DA Form 285-1 Data (n=59)	Estimated for 1986 (n=637)	Estimated for 1983-1987 (n=3,060)
Accidents	2	22	104
Injuries	2	22	104
Days Lost	81	875	4,201
Injury Cost	11,200	120,922	580,881
Total Cost	$11,200	$120,922	$580,881

Description: The handler used proper procedures while pushing or pulling objects. However, the object being pushed or pulled weighed in excess of the employees capabilities.

Causes:

1. Overconfidence (100%)

Example: An Army civilian employee was injured when he was pulling a loaded cart from the back of a delivery truck. He was overconfident in his ability to move the fully loaded cart.

3.2.1.2 Team Activities

Team activities include those accidents identified in the in-depth reports that were being performed by a team at the time of the accident. This includes accidents that indicated that the team was handling a load in excess of their capabilities. All accidents identified in the in-depth reports for team activities involved lifting.

3.2.1.2.1 Lift (5)

	DA Form 285-1 Data (n=59)	Estimated for 1986 (n=637)	Estimated for 1983-1987 (n=3,060)
Accidents	5	54	259
Injuries	5	54	259
Days Lost	201	2,170	10,425
Injury Cost	26,995	291,454	1,400,080
Total Cost	$26,995	$291,454	$1,400,080

Description: Teams used proper procedures or a procedural violation was not identified while lifting objects. However, the object being lifted was bulky or weighed in excess of the capabilities of the team.

Causes:

1. Inadequate Direct Supervision (60%)

Example: A National Guard soldier and three assistants made an improper decision when lifting a ramp. One of the soldiers injured his groin when performing the lift. The soldier was not given any indication of the number of individuals needed to perform the task (inadequate supervision).

2. Overconfidence in Self (20%)

Example: Two active duty soldiers were unloading boards from the back of a truck when one of the employees dropped his end of the board. Due to their overconfidence in their abilities the failed to anticipate the weight of the board.

3. Inadequate Experience (20%)

Example: A National Guard soldier was lifting pioneer tool boxes with the assistance of three other soldiers and twisted his left hand. He did not use a proper lifting position with his left hand because of inadequate experience.

3.2.2 Improper Techniques

This category includes actions where the handler failed to use proper procedures while lifting, carrying or moving objects. This category is concerned with the proper use of body techniques in accordance with DOD 4145.19-R-1 and the adherence to standard operating procedures (SOPs) when handling materiels. That is, failing to bend at the knees when lifting or handling materiels not in excess of procedural limits. The accidents identified as "Improper Techniques" were further substantiated by reviews of the system inadequacies and the recommended actions.

This category has also been divided further to indicate if the accident occurred during lifting, carrying or lateral (push/pull) operations. These subcategories are defined as follows:

a. Lift: Poor lifting techniques, such as failure to bend at the knees and reaching too far to grasp a load.

b. Carry: Poor carrying techniques, such as carrying objects improperly, or over too great a distance.

c. Lateral Movement: Improper push/pull technique.

Hazards: This problem area presents potential hazards to individuals when attempting to lift, carry or move objects without applying the proper procedures. Individuals must continuously be aware of the potential danger of materiel handling functions. Failure to scope the task, and evaluate and apply proper techniques cause most injuries in this category. Injuries to back, neck, abdominal or limb areas are common to this type of hazard.

3.2.2.1 Improper Techniques - Lift (15)

	DA Form 285-1 Data (n=59)	Estimated for 1986 (n=637)	Estimated for 1983-1987 (n=3,060)
Accidents	15	162	778
Injuries	16	173	830
Days Lost	626	6,759	32,467
Injury Cost	70,740	763,752	3,668,888
Total Cost	$70,740	$763,752	$3,668,888

Description: The handler failed to use proper procedures while lifting objects. This includes failure to bend at the knees when lifting or lifting loads in excess of procedural limits. This category is concerned with the proper use of body techniques in accordance with DOD 4145.19-R-1, Chapter 6.

Causes:

1. Overconfidence (41%)

Example: A National Guard soldier was unloading a truck with another employee when he suffered an inguinal hernia. Because of his overconfidence in his ability to lift the item, he failed to seek assistance from his helper. See DOD 4145.19-R-1, Chapter 6, Paragraph 114.

2. Inadequate Motivation (24%)

Example: An Army reserve soldier injured his shoulder when he incorrectly lifted supplies from a truck. He did not use the proper lifting techniques because he was inadequately motivated.

3. Inadequate Attention (17%)

Example: An Army civilian employee was injured when he was lifting small boards and minor trash. He was so involved in removing the trash that he failed to pay adequate attention to the weight of the item he was lifting.

4. Inadequate Direct Supervision (6%)

Example: An Army civilian employee was injured when she lifted a box that weighed in excess of her profile. The supervisor failed to ensure that her profile was being met.

5. Insufficient Information (12%)

There was sufficient information to determine the problem area; however, insufficient information was provided in the DA Form 285-1 to determine the system inadequacy.

3.2.2.2 Lateral Movement (2)

	DA Form 285-1 Data (n=59)	Estimated for 1986 (n=637)	Estimated for 1983-1987 (n=3,060)
Accidents	2	22	104
Injuries	2	22	104
Days Lost	82	885	4,253
Injury Cost	12,700	137,117	658,678
Total Cost	$12,700	$137,117	$658,678

Description: The handler failed to use proper procedures while pushing or pulling objects. This category is concerned with the proper use of body techniques in accordance with DOD 4145.19-R-1 Chapter 6.

Causes:

1. Inadequate Attention (50%)

Example: Employee injured his back pushing a box into position on the back of a truck. Due to inadequate attention, the employee used improper lifting and loading techniques. See DOD 4145.19-R-19, Chapter 6, Paragraph 6-114.

2. Overconfidence in Self (50%)

Example: A civilian employee injured his arm pulling a mattress from a semi-trailer without assistance. The employee was overconfident in his abilities and did not seek assistance.

3.2.3 Unsecured Loads (7)

	DA Form 285-1 Data (n=59)	Estimated for 1986 (n=637)	Estimated for 1983-1987 (n=3,060)
Accidents	7	76	363
Injuries	7	76	363
Days Lost	266	2,872	13,796
Injury Cost	49,385	533,191	2,561,324
Total Cost	$49,385	$533,191	$2,561,324

This category includes items that fall because they are unstable, tipped-over when contacted, or were dropped in the attempt to lift or carry them, whether that attempt was made manually or by use of equipment. This category includes loads that shift during materiel handling, i.e., slid or fell due to loading or unloading operations. The "Unsecured Loads" Problem Area also includes accidents caused by unsecured objects that fell or slid during materiel access or personnel movement, i.e., bumped into an object causing it to fall.

Hazards: This problem area presents potential hazards to individuals in the area near the falling objects, whether they are the handler or are bystanders in the vicinity of the activity. This problem area also has the potential for serious injury. Injury is often caused by the handler or other individuals trying to catch or stop the movement of the object. Serious injury, such as broken bones and severe cuts and bruises can result from these hazards.

Causes:

1. Inadequate Experience (29%)

Example: A team of active duty soldiers were loading stove grills onto a truck when one of the grills slid off and fell on a soldiers foot, fracturing a bone. The soldiers were inexperienced in the proper methods to follow when loading a truck.

2. Inadequate Attention (14%)

Example: A National Guard soldier moved a box that was supporting a training round and the round fell on his foot and fractured a bone. The soldier did not see the training round (inadequate attention) before he moved the box.

3. Overconfidence (14%)

Example: An Army civilian employee's leg was fractured when a stack of frames he was trying to support fell on it. He was overconfident is his ability to steady the load which fell when a fork lift picked up the load.

4. Inadequate Motivation/Mood (14%)

Example: A Foreign national employee was unloading fabric from the back of a truck when a roll fell and injured his thumb. He was acting hastily (inadequate motivation) so he could return the AMV to the motor pool.

5. Insufficient Information (29%)

There was sufficient information to determine the problem area; however, insufficient information was provided in the DA Form 285-1 to determine the system inadequacy.

3.2.4 Climbing On or Off Vehicles (9)

	DA Form 285-1 Data (n=59)	Estimated for 1986 (n=637)	Estimated for 1983-1987 (n=3,060)
Accidents	9	97	467
Injuries	9	97	467
Days Lost	344	3,714	17,841
Injury Cost	54,830	591,978	2,843,725
Total Cost	$54,830	$591,978	$2,843,725

This category includes those materiel handling accidents that occur when materiel handlers are loading or unloading vehicles. These accidents are caused by hazardous footing including uneven surfaces or tripping hazards. Such accidents are common in or out of the materiel handling environment. The act of materiel handling, however, compounds the potential for these types of accident occurrences.

Hazards: This problem area presents hazards to the materiel handler that are not directly associated with the materiel that is being handled. The hazards associated with vehicles include tripping and falling hazards (i.e., tie downs, antennas, etc.,) and slippery surfaces.

Causes:

1. Inadequate Motivation (40%)

Example: An Army civilian employee acted hastily (inadequate motivation) and did not place his foot securely on the bumper when he dismounted the vehicle (during an unspecified materiel handling activity). He fell and fractured his left leg.

2. Inadequate Experience (10%)

Example: A national guard soldier's finger was pinched between the tailgate and the bumper of a dump truck when the tailgate dropped. He failed to anticipate that the tail gate might not be locked because he was not experienced in the operation of a 5-ton truck.

3. Inadequate Attention (10%)

Example: An active duty soldier fell from a truck when he tripped on the antenna and fractured his pelvis. He failed to pay adequate attention when he was unloading the truck.

4. Inadequate Direct Supervision (10%)

Example: A foreign national employee attempted to enter a truck by climbing over the tailgate and fell when the gate suddenly opened (during an unspecified materiel handling activity). The employee's supervisor had failed to provide the proper guidance (inadequate direct supervision).

5. Insufficient Information (30%)

There was sufficient information to determine the problem area; however, insufficient information was provided in the DA Form 285-1 to determine the system inadequacy.

3.2.5 Equipment Usage (4)

	DA Form 285-1 Data (n=59)	Estimated for 1986 (n=637)	Estimated for 1983-1986 (n=3,060)
Accidents	4	43	207
Injuries	4	43	207
Days Lost	96	1,036	4,979
Injury Cost	16,755	180,897	868,988
Total Cost	$16,755	$180,897	$868,988

This category includes the use of equipment in an improper manner, incorrectly, or for a purpose for which it was not designed. This may include improvising with a piece of equipment to perform a task that could be more efficiently and safely performed with an existing piece of equipment.

Hazards: This problem area presents potential hazards to individuals when improper use of equipment creates unsafe conditions. This problem area is particularly dangerous to the individual, in that, it can generate hazards far greater to the individual than the object being moved (e.g., flying objects, moving equipment, etc.) Serious injury, such as broken bones and severe cuts and bruises can result from these hazards.

Causes:

1. Inadequate Experience (20%)

Example: An active duty soldier climbed onto a loaded pallet and pulled on an unsecured tie-down strap and fell injuring himself. Because of his inadequate experience he failed to check the tie-down straps to ensure that they were properly fastened.

2. Inadequate Composure (20%)

Example: An Army civilian employee failed to lock the wheels on a cart before loading the cart and it rolled over his foot. The employee tried to stop the rolling cart with his foot because of inadequate composure.

3. Inadequate Attention (20%)

Example: An Army civilian employee misjudged the clearance of the fork lift forks and dropped a steel bar from a storage rack on the foot of another employee. He was inattentive and failed to ensure there was adequate clearance for the forks and knocked the bar from the rack.

4. Inadequate Supervision by Staff Officer (20%)

Example: A direct supervisor had in the past allowed the use of the incorrect tank cart to move gas cylinders. Therefore, when the civilian used the incorrect cart, she lost control of the load and strained her back trying to regain control of the load.

5. Insufficient Information (20%)

There was sufficient information to determine the problem area; however, insufficient information was provided in the DA Form 285-1 to determine the system inadequacy.

3.2.6 Singular Problem Areas (2)

This is a collection of accidents that appear to occur infrequently (i.e, one or fewer accidents in the in-depth reports) during loading or unloading activities. There are insufficient data to project, with any degree of confidence, the future consequences of these problems. The accidents, examples 1 and 2 are the result of "Trips, Slips or Falls."

1. Example 1 - Trips, Slips or Falls: An Army civilian employee was unloading irrigation pipe and slipped on the uneven ground. He lost his balance and wrenched his back. There was insufficient information to identify a system inadequacy. This accident resulted in 33 days lost and $3,300 in injury and total costs.

2. Example 2 - Trips, Slips or Falls: A National Guard soldier was entering a building when he slipped on a wet floor (during an unspecified materiel handling activity). The floors were wet because of inadequate services, i.e., there were no signs indicating the floor was wet and the melted snow had not been mopped up. This accident resulted in 22 days lost and $2,640 in injury and total costs.

3.3 OTHER MATERIEL HANDLING CATEGORIES

This category includes accidents that can not be attributed to transportation or loading and unloading activities. There is also an insufficient number of accidents or information for each of the materiel handling activities represented in this category to make accurate accident and injury projections. There were 10 accidents, of which 9 were due to human errors or Army system inadequacies. The materiel handling activities included in this category are (number in parenthesis represent the number of incidents): 1) Inventorying or inspecting (3); 2) Packing or preserving (2); 3) Palletizing, sling loading or rigging (2); 4) Withdrawing or retrieving (2); and 5) Marking, labeling, or pricing (1). An analysis of these activities was performed and the problem areas identified in the analysis were combined across the activities. The following are the results of the analysis.

3.3.1 Handling Excessive Loads - Lifting (4)

	DA Form 285-1 Data (n=9)	Estimated for 1986 (n=372)	Estimated for 1983-1987 (n=1,679)
Accidents	4	165	746
Injuries	4	165	746
Days Lost	110	4,547	20,521
Injury Cost	13,075	540,433	2,439,214
Total Cost	$13,075	$540,433	$2,439,214

This problem area includes handling excessive loads either in a vertical or horizontal plane. Loads may be excessive either in weight or size. Loads are excessive when the weight or size of the object is too great for the manpower resources applied to the task, whether that task is performed by an individual or a group. These accidents were selected by reviewing the task error, the system inadequacy and the recommended actions to determine if the load was in excess of the handlers capabilities. These accidents involved individuals lifting loads in excess of their capabilities.

Hazards: This problem area presents potential hazards to individuals or teams when the lifting of objects is attempted without the application of adequate manpower resources or the use of equipment. Injuries to back, neck, abdominal or limb areas are common to this type of hazard.

Causes:

1. Inadequate Attention (25%)

Example: An Army civilian employee (Inspector) injured his back when he lifted a 5 gallon paint can improperly. He was inspecting a contractor and was not paying attention when lifted the can improperly.

2. Improper Use of Tool or Equipment (25%)

Example: An Army civilian employee (Packer) suffered a hernia when he lowered a piece of equipment improperly. He failed to seek assistance or did not use the available equipment when lowering the awkward load in to its container.

3. Insufficient Information (50%)

There was sufficient information to determine the problem area; however, insufficient information was provided in the DA Form 285-1 to determine the system inadequacy.

3.3.2 Singular Problem Areas (5)

This is a collection of accidents that appear to occur infrequently (i.e, one or fewer accidents in the in-depth reports). There are insufficient data to project, with any degree of confidence, the future consequences of these problems. One of the accidents, Example 1, was the result of "Handling Excessive Loads - Lateral Movements." Example 2 involved an "Unsecured Load." Examples 3 and 4 are the result of "Trips, Slips or Falls" and Example 5 involves handling "Cutting Equipment."

1. Example 1 - Handling Excessive Loads - Lateral Movement: An Army civilian employee was moving a T-130 track with a forklift and attempted to pull the track off the forklift blade. There was insufficient information to determine the system inadequacy. The result of this accident was 30 days lost and $3,000 injury and total costs.

2. Example 2 - Unsecured Loads: A foreign national employee (Palletizer) brushed against a projectile causing it fall and fracture the foot of another employee. There were two system inadequacies identified, one was inadequate direct supervision (i.e., the supervisor was not observing the operation) and the other was inadequate written procedures. The result of this accident was 31 days lost and $2,325 injury and total costs.

3. Example 3 - Trips, Slips or Falls: A foreign national employee (Inventorying) tripped and fell over a push cart that was left unattended in the aisle way. There was no system inadequacy identified in the in-depth accident report. The result of this accident was 75 days lost and $9,750 injury and total costs.

4. Example 4 - Trips, Slips or Falls: A foreign national employee (Withdrawing) was removing heater pipes from a beam line at the warehouse using a ladder. Because of his inadequate experience, he lost his balance and fell from the ladder. The result of this accident was 20 days lost and $1,500 injury and total costs.

5. Example 5 - Cutting Equipment: An active duty soldier (Packer) placed her hand on a hatchet laying on the counter top and severed her right index finger. She was not paying adequate attention and did not look where she was placing her hand. The result of this accident was 15 days lost and $43,000 injury and total costs.

3.4 SUMMARY OF HUMAN ERROR ACCIDENTS

The preceding sections discuss the problems areas specific to each of the two materiel handling categories. Table 3.3 summarizes the problem areas by materiel handling category. The major problem area for materiel handling is "Handling Excessive Loads." There were 165 in-depth reports received; 150 could be identified as materiel handling accidents, including 6 accidents that were not caused by human error (i.e., caused by materiel failure or environment). Fifteen were determined to be either not materiel handling or insufficient information was provided to determine the cause of the accident or injury. Of the 150 accidents and $869,050 in total costs, 144 accidents and $823,625 were due to human errors.

"Handling Excessive Loads" accounted for 58 of the 144 identifiable human error accidents and $344,295 in injury and damage costs. "Handling Excessive Loads" represented 40 percent of the human error accidents and 42 percent of the total human error costs of $823,625. The system inadequacy identified in the majority of the accidents was the employee's overconfidence when handling materiel. That is, although the employee followed the proper handling procedures, the materiel weighed in excess or was too bulky to be handled by someone fitting the employees profile, i.e., size, lifting capability, etc,.

The second highest cause of accidents was "Improper Techniques." This problem area accounted for 35 percent of the accidents or 50 of the 144 identifiable accidents. These accidents were second in total costs, representing 29 percent of the total human error costs. The system inadequacy in the majority of these accidents was also the employees' overconfidence in his/her capabilities. However,in these accidents the employee ignored the established policies or the proper procedures and handled materiel incorrectly or in excess of their procedural limits.

TABLE 3.3. Summary of DA Form 285-1 Materiel Handling Accident Data For the Targeted Year FY 1986

Problem Area	Transportation	Unloading	Other Materiel Handlers	Totals
Excessive Loads				
Accidents	33	20	5 (a)	58
Injuries	33	20	5	58
Days Lost	1,293	742	140	2,175
Injury Costs	222,915	105,305	16,075	344,295
Total Costs	$222,915	$105,305	$16,075	$344,295
Improper Techniques				
Accidents	33	17	0	50
Injuries	33	18	0	51
Days Lost	1,231	708	0	1,939
Injury Costs	157,455	83,440	0	240,895
Total Costs	$157,455	$83,440	$0	$240,895
Unsecured Loads				
Accidents	7	7	1 (a)	15
Injuries	7	7	1	15
Days Lost	285	266	31	582
Injury Costs	35,700	49,385	2,325	87,410
Total Costs	$35,700	$49,385	$2,325	$87,410
Climbing On or Off Vehicles				
Accidents	0	9	0	9
Injuries	0	9	0	9
Days Lost	0	344	0	344
Injury Costs	0	54,830	0	54,830
Total Costs	$0	$54,830	$0	$54,830
Equipment Usage				
Accidents	0	4	0	4
Injuries	0	4	0	4
Days Lost	0	96	0	96
Injury Costs	0	16,755	0	16,755
Total Costs	$0	$16,755	$0	$16,755
Materiel Failure				
Accidents	1	3	0	4
Injuries	1	3	0	4
Days Lost	28	111	0	139
Injury Costs	2,800	12,600	0	15,400
Total Costs	$2,800	$12,600	$0	$15,400
Environment				
Accidents	0	1	1	2
Injuries	0	1	1	2
Days Lost	0	195	24	219
Injury Costs	0	27,625	2,400	30,025
Total Costs	$0	$27,625	$2,400	$30,025
Singular Problem Areas				
Accidents	3	2	3	8
Injuries	3	2	3	8
Days Lost	125	55	110	290
Injury Costs	19,250	5,940	54,250	79,440
Total Costs	$19,250	$5,940	$54,250	$79,440
TOTAL				
Accidents	77	63	10	150
Injuries	77	64	10	151
Days Lost	2,962	2,517	305	5,784
Injury Costs	438,120	355,880	75,050	869,050
Total Costs	$438,120	$355,880	$75,050	$869,050

Others not analyzed	
No Fault	1
Not Materiel Handling	8
Insufficient Information	6

(a) Accident(s) discussed in Singular Problem Areas Subsection

The third highest cause of materiel handling accidents is "Unsecured Loads." These accidents accounted for approximately 10 percent of the accidents, or 15 of the 144 identifiable accidents. "Unsecured Loads" account for $87,410 in total costs or 11 percent of the total costs. These accidents were primarily caused by items falling when a supporting item was removed from storage or from a vehicle, or by items falling when placed in storage or a vehicle. The employees' lack of experience or motivation were the system inadequacies most often identified in the accident reports.

The remaining accidents fell into two unique problem areas, "Climbing On or Off Vehicles" and "Equipment Usage", and the singular problem area. "Climbing On or Off Vehicles" accounted for about 6 percent of the accidents and 7 percent of the costs. "Equipment Usage" accounted for approximately 3 percent of the accidents and 2 percent of the costs. Figure 3.1 summarizes graphically the results of the analysis of the DA Form 285-1 data.

Table 3.4 presents the system inadequacies associated with each of the problem areas. There were a total of 124 (excluding the 35 insufficient information) system inadequacies identified by the trained safety personnel

TABLE 3.4. Summary of the System Inadequacies as Identified by Problem Area for the Targeted Year FY 1986

System Inadequacy	Handling Excessive Loads	Procedural Errors	Equipment Usage	Unsecured Loads	Climbing On/Off Vehicles	Singular Problem Areas	TOTAL
Overconfidence[a]	18	15	0	1	0	0	34
Inadequate Attention[a]	4	9	1	3	1	3	21
Inadequate Motivation[a]	4	9	0	2	4	0	19
Inadequate Supervision by Direct Supervisor	8	4	1	0	1	1	15
Inadequate Experience	4	2	1	2	1	1	11
Inadequate Unit Training	4	2	0	0	0	0	6
Habit Interference	0	4	0	1	0	0	5
Inadequate Facilities	1	2	0	0	0	1	4
Inadequate Written Procedures	2	0	0	0	0	1	3
Improper use of Equipment	2	0	0	0	0	0	2
Inadequate Maintenance	0	0	0	1	0	0	1
Fatigue	0	0	0	0	0	1	1
Inadequate Supervision by Staff Officer	0	0	1	0	0	0	1
Inadequate Composure[a]	0	0	1	0	0	0	1
Sub-Total	47	47	5	10	7	8	124
Insufficient Information	13	10	1	4	3	4	35
Total	60	57	6	14	10	12	159

(a) Combined into inadequate self-discipline.

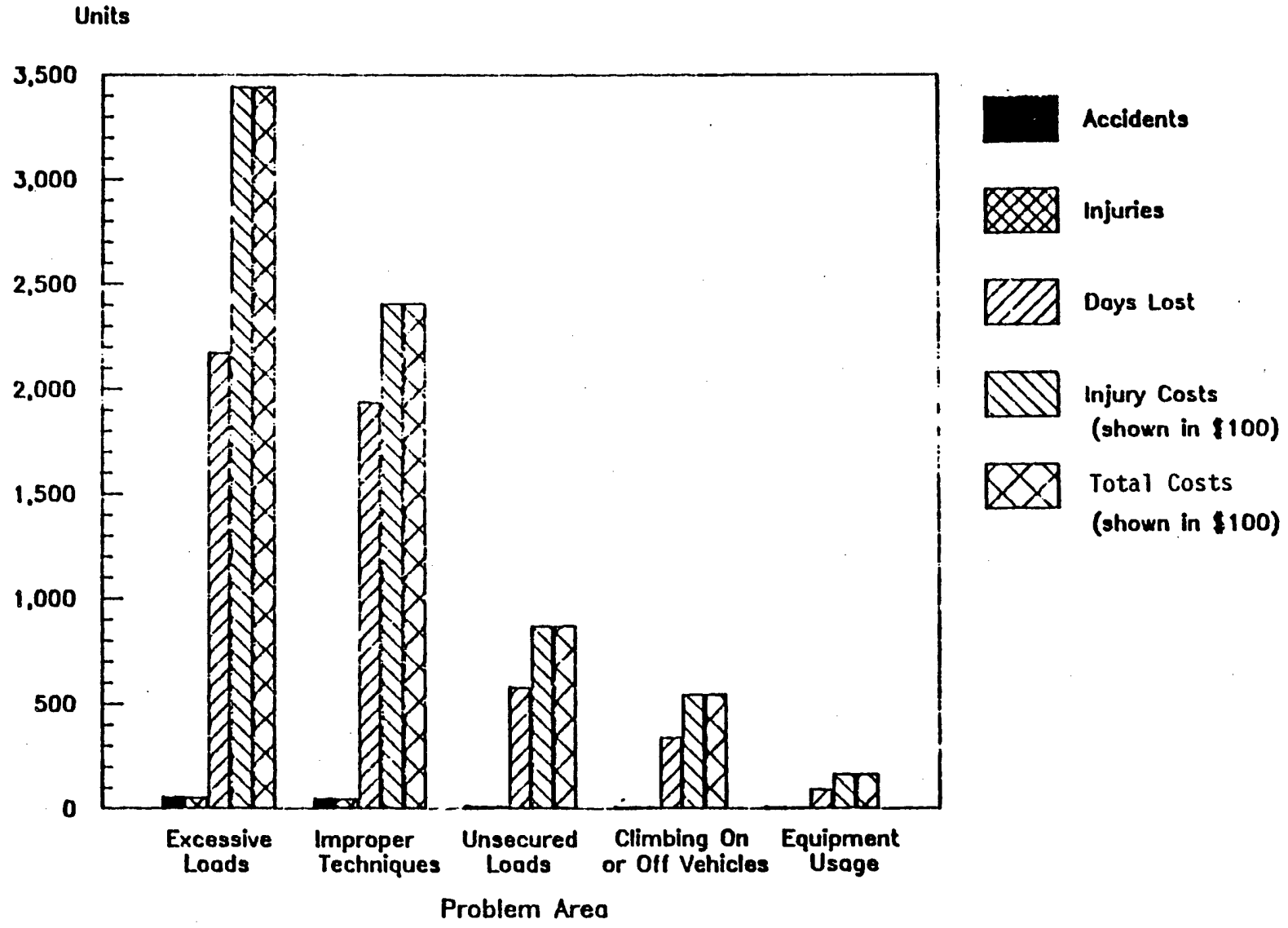


FIGURE 3.1. Summary of Materiel Handling Accidents Attributed to Human Errors by Problem Area

and reported in the in-depth reports. The top five system inadequacies identified in the analysis are: 1) Overconfidence in Self or Others; 2) Inadequate Attention; 3) Inadequate Motivation; 4) Inadequate Direct Supervision by a Direct Supervisor; and 5) Inadequate Experience.

Overconfidence in self or others accounted for 21 percent or 34 of the 124 identified system inadequacies. The majority of these were identified in the Problem Area called "Handling Excessive Loads." Inadequate attention was identified in 21 (17 percent) of the 124 system inadequacies. Nine of these were reported in the problem area called "Improper Techniques. "Inadequate motivation, or acting hastily, was identified 19 (12 percent) times in the accident reports as an Army safety system inadequacy. The majority of these were again identified in the "Handling Excessive Loads" Problem Area. The fourth system inadequacy identified in the accident reports was inadequate direct supervision by a direct supervisor. This system inadequacy was identified in 15 of the 124 system inadequacies for 12 percent of the total. The fifth system inadequacy, inadequate experience, accounted for approximately 9 percent of the total or 11 of the 124.

Overconfidence, inadequate motivation, and inadequate attention, along with inadequate composure, and lack of confidence can be combined into a larger group called "inadequate self-discipline." This inadequacy combines the self-generated system inadequacies. Inadequate self-discipline accounts for 60 percent of the inadequacies causing these serious materiel handling accidents.

3.5 MATERIEL FAILURE

This problem area includes materiel failures that are directly applicable to materiel handling equipment. There were four materiel failures; therefore, this problem area was not broken into sub-categories. Two of the materiel failures involved deteriorated truck beds, one involved a broken band on a loaded truck and one involved a sharp edge on a piece of furniture that was being moved.

Both the deteriorated truck beds materiel failures occurred at Fort Lewis. One was attributed to environmental conditions and the cause of the other deteriorated truck bed was not identified. The failure of a packaging band was attributed to inadequate packaging, i.e., the tension on the band was greater than expected and struck an employee when it was cut. An employee was cut by a sharp edge on a file cabinet, this was identified as a materiel failure due to inadequate quality control.

3.6 ENVIRONMENT

This problem area includes accidents that were caused by environmental conditions at the time of the accident. There were two accidents identified in the DA Form 285-1 data. One was caused by wet, muddy conditions. This involved a slip and fall due to wet, muddy and cold conditions. The system inadequacy identified in this accident was inadequate facilities, i.e., there were no facilities to protect personnel from the environment.

The second accident was caused by gusting winds. An employee was returning the log books to a vehicle when a gust of wind blew the door shut injuring the employee's back.

3.7 MILITARY MATERIEL HANDLING ACCIDENTS FOR FY 1987-1988

An additional analysis of the ASMIS database was performed, analyzing military materiel handling accidents for the two-year period, FY 1987-1988. This analysis did not include civilian and non-military workers because of the changes in reporting and accident recording procedures implemented mid-year FY 1987. The results of this analysis are shown in Table 3.5.

As in the previous four years, the greatest percentage of accidents involving military personnel occurred during loading or unloading. Loading or unloading accounted for approximately 49 percent of the accidents, or 530 of the 1,090 total accidents for the two-year period. Transportation accounted for 397 of the 1,090 accidents or approximately 36 percent. Comparing these percentages to the percentages for the four-year period (see Table 3.1), it can be seen than transportation and loading and unloading accidents have remained relatively constant.

TABLE 3.5. Summary of Military Materiel Handling Accidents for the Two-Year Period FY 1987-1988

	Transportation	Loading or Unloading	Other Materiel Handling Categories	Totals
Accidents	397	530	163	1,090
Injuries	399	533	171	1,103
Days Lost	4,010	5,734	1,912	11,656
Injury Costs	$1,079,285	$1,466,210	$798,085	$3,343,580
Damage Costs	112,033	1,960	166,133	280,126
Total Costs	$1,191,318	$1,468,170	$964,218	$3,623,706

3.8 MILITARY OCCUPATIONAL SPECIALTIES

There a total of 273 Military Occupational Specialties (MOSs) for Enlisted personnel identified in the database for the four-year period FY 1983-1987. There are seven MOSs with greater than 100 injuries, forty with 10 or more and less than 100 injuries, and 225 with less than 10 injuries (see Table 3.6).

The seven MOS's that had more than 100 injuries for the four-year period, FY 1983-1986 are: 1) Canon Crewmember (198 or 8 percent); 2) Combat Engineer (145 or 6 percent); 3) Motor Transport Operator (133 or 5 percent); 4) Unit Supply Specialist (133 or 5 percent); 5) Food Service Specialist (126 or 5 percent); 6) Infantryman (125 or 5 percent); and 7) Light Wheel Vehicle Mechanic (120 or 5 percent). These seven MOSs represent 3 percent of the total 273

MOSs identified in materiel handling accidents and 38 percent of the injuries to enlisted military personnel or 980 of the 2,547. Injuries to Commissioned Officers accounted for 2 percent of the 2,637 injuries, or 57. Injuries to Warrant Officers accounted for 1 percent of the total or 33.

After the enlisted MOSs with greater than 100 injuries were identified, an analysis of these MOSs was performed to categorize the accidents data by activity. The commissioned and warrant officer data were categorized in a similar manner. The results, shown in Table 3.7, indicate that, for the seven MOSs identified, more injuries occur during loading or unloading than occur during transportation or other materiel handling operations. For officers, more injuries occur during transportation than during loading or unloading or other materiel handling operations.

For the six-year period, there are eight MOSs with greater than 100 injuries. This includes the seven MOSs identified in the four-year analysis plus Armor Crewman (M48-M60) (111).

3.9 CIVILIAN WORKER FAMILIES

An analysis was performed of the ASMIS database to determine which families of civilian workers are commonly involved in materiel handling accidents. There were 178 unique general schedule and 357 unique wage grade worker categories identified in the database (see Table 3.8). Seven of the families (6 - Wage Grade and 1 - General Schedule) had more than 100 injuries, 47 had 10 or more but less than 100, and 481 had less than 10 injuries. The worker families with more than 100 injuries were evaluated in the same manner as the Military Occupational Specialties.

From Table 3.9, the majority of the injuries for each worker family occurred during transportation activities, except for the motor vehicle operator worker family. Transportation, on the whole for the seven families, accounted for 43 percent of the injuries, loading and unloading accounted for 34 percent and other materiel handling categories accounted for 23 percent of the injuries.

TABLE 3.6. Summary of Injuries by Military Occupational Specialty For the Period FY 1983-1988

Military Occupational Specialty	Number of Injuries FY 83-86	FY 87-88	Total
Enlisted			
Cannon Crewmember	198	61	259
Combat Engineer	145	28	173
Motor Transport Operator	133	26	159
Unit Supply Specialist	133	57	190
Food Service Specialist	126	73	199
Infantryman	125	58	183
Light Wheel Vehicle Mechanic	120	43	163
Armor Crewman (M48 - M60)	82	29	111
Military Police	58	27	85
Indirect Fire Infantryman	51	14	65
Materiel Storage and Handling Specialist	48	17	65
Medical NCO	37	3	40
Calvary Scout	34	11	45
Armor Crewman (M1)	33	22	55
Track Vehicle Repairer	33	15	48
Administrative Specialist	33	12	45
Materiel Control and Accounting Specialist	31	3	34
Wire Systems Installer	29	9	38
Construction Equipment Repairer	28	8	36
Petroleum Supply Specialist	28	2	30
Cannon Fire Detection Specialist	25	6	31
Carpentry and Masonry Specialist	23	8	31
Heavy Construction Equipment Operator	21	17	38
Medical Specialist	19	20	39
Unit Level Communications Maintainer	19	9	28
Bridge Crewmember	19	8	27
Tank System Mechanic (M60A1/A3)	19	2	21
Ammunition Specialist	18	9	27
Fire Support Specialist	18	12	30
Nuclear, Biological and Chemical Specialist (Rescinded)	18	9	27
Tactical Telecommunications Center Operator	18	2	20
Equipment Records and Parts Specialist	17	14	31
Multichannel Communications Systems Operator	17	11	28
Subtotal for page	1,756	645	2,401

TABLE 3.8. Summary of Injuries by Civilian Worker Family for the Four-Year Period FY 1983-1986

Civilian Worker Family	Number of Injuries	Percent of the Subtotal by Job Title
Wage Grade Employees		
Warehouse worker	757	20
Heavy Equipment Mechanic	223	6
Laborer	173	5
Motor Vehicle Operator	141	4
Packer	121	3
Maintenance Mechanic	110	3
Carpenter	95	3
Air Conditioning Mechanic	81	2
Fork Lift Operator	65	2
Meat Cutter	57	2
Electrical Installer and Repairer	50	1
Radar Equipment Installer and Repairer	49	1
Plumber	44	1
Painter	42	1
Tool and Parts Attendant	40	1
Sheet Metal Mechanic	35	1
Welder	32	1
Crane Operator	29	1
Heating Equipment Mechanic	29	1
Machinist	28	1
Wood Worker	27	1
Aircraft Mechanic	27	1
Craftsman	26	1
Electrical Cable Splicer	25	1
Materiels Expediter	23	1
Pipefitter	22	1
Custodian	18	<1
Tractor Operator	17	<1
Boiler Plant Operator	16	<1
Artillery Repairer	13	<1
Blocker and Bracer	13	<1
Cook	12	<1
Gardener	12	<1
Sewage Disposal Plant Operator	12	<1
Water Treatment Plant Operator	12	<1
Machine Tool Operator	11	<1
Sandblaster	11	<1
Mason	10	<1
Electroplater	10	<1
Electrician (Unidentified)	10	<1
Small Arms Repairer	10	<1
Equipment Cleaner	10	<1
Others with less than 10 Accidents	1,225	32
Total for Wage Grade	3,773	

TABLE 3.6. Cont'd

Military Occupational Specialty	Number of Injuries FY 83-86	FY 87-88	Total
Power Generation Equipment Repairer	17	18	35
Wheel Vehicle Repairer	17	9	26
Metal Worker	17	7	24
Heavy Anti-armor Weapons Infantryman	16	8	24
Combat Signaler	16	11	27
System Mechanic (BFV)	14	9	23
Utility Helicopter Repairer	13	8	21
Practical Nurse	13	5	18
Field Artillery Surveyor	13	2	15
Single Channel Radio Operator	12	14	26
Signal Operations (Unidentified)	12	0	12
Crane Operator	12	4	16
Heavy Wheel Vehicle Mechanic	11	2	13
Interior Electrician	10	4	14
Fighting Vehicle Infantryman	6	12	18
Sub-Total	199	113	312
MOS's with less than 10 accidents	592	307	899
Subtotal from Page 1	1,756	645	2,401
Sub-Total Enlisted	2,547	1,065	3,612
Commissioned Officers	57	26	83
Warrant Officers	33	12	45
Total	2,637	1,103	3,740

TABLE 3.7. Summary of Injuries by Materiel Handling Category For The Top Seven Enlisted Military Occupational Specialties & Officers for the Four-Year Period

Military Occupational Specialty	FY 83-86	Trans-portation	Loading/ Unloading	Other Materiel Handling Categories
Enlisted				
Cannon Crewmember	198	69	97	32
Combat Engineer	145	57	76	12
Motor Transport Operator	133	31	80	22
Unit Supply Specialist	133	49	62	22
Food Service Specialist	126	40	76	10
Infantryman	125	47	58	20
Light Wheel Vehicle Mechanic	120	47	59	14
Sub-Total	980	340	508	132
Commissioned Officers	57	25	12	20
Warrant Officers	33	26	6	1
Sub-Total	90	51	18	21
Other MOSs	1,567	627	690	224
Total	2,637	1,018	1,216	377

TABLE 3.8. Cont'd

Civilian Worker Family	Number of Injuries	Percent of the Subtotal by Job Title
General Schedule Employees		
Supply Technician	140	15
Sales Store Clerk	40	4
Miscellaneous Clerks and Assistants	38	4
Mail and File Clerks	31	3
Clerk (Typing)	30	3
Firemen	30	3
Recreation Assistant	26	3
Engineering Aid	24	2
Engineer (Unidentified)	22	2
Secretary (Typing)	21	2
Computer Operations	20	2
Computer Clerk	12	1
Others with less than 10 Accidents	527	55
Total for General Schedule	961	
Other Employees	1,855	
Total for Wage Grade (page 1)	3,773	
Total	6,589	

TABLE 3.9. Summary of Injuries for the Top Materiel Handling Categories and Civilian Worker Families For FY 1983-1986

Civilian Worker Family	Number of Injuries	Trans-portation	Loading or Unloading	Other Materiel Handling Categories
General Schedule Employees				
Supply Technician	140	63	38	39
Wage Grade Employees				
Warehouse worker	757	354	267	136
Heavy Equipment Mechanic	223	103	40	80
Laborer	173	91	50	31
Motor Vehicle Operator	141	48	77	16
Packer	121	51	16	54
Maintenance Mechanic	110	52	44	14
Sub-Total	1,574	672	532	370
Others with less than 100 Injuries	5,015	2,759	1,318	938
Total	6,589	3,431	1,850	1,308

3.10 MAJOR ARMY COMMANDS

Accident data contained in ASMIS were analyzed by Major Army Command (MACOM) and are shown in in Table 3.10. From Table 3.10 it can be seen that 72 percent, or 6,572 of the 9,183 accidents involve civilians and that military accidents account for 2,611 accidents or 28 percent of the total. Seventy-one percent of the accidents occur at four MACOMs: 1) Forces Command (FORSCOM); 2) US Army Europe (USAREUR); 3) National Guard (N GUARD); and 4) Army Materiel Command (AMC). The table shows that, with the exceptions of the National Guard, the 8th Army and Intelligence and Security Command, civilian accidents are more frequent than military accidents.

FORSCOM accounted for 1,954 accidents and of these accidents 60 percent or 1,171 involved civilians and 40 percent or 783 involved military personnel. At USAREUR, 1,241 of the accidents involved civilians and 470 accidents involved military personnel, or 73 and 27 percent, respectively. The National Guard, when compared to all MACOMs analyzed, ranked the highest in the number of accidents involving military personnel, or 1,017 accidents accounting for 39 percent of all military accidents. Of all MACOMs, AMC installations ranked the highest in accidents involving civilian employees. Ninety-eight percent or 1,387 of the 1,409 accidents that occurred at AMC involved civilians.

An additional analysis was performed to compare the military accidents by MACOM for the four-year period to the military accident data for the period, FY 1987-1988. The results are shown in Table 3.11. With the exception of the National Guard (which decreased by about 6 percent) the percentage of total accidents for each MACOM have remained relatively constant.

3.11 PHYSICAL LOCATIONS

Accident data contained in ASMIS were analyzed by physical location, i.e., the facility, building, or area. The results of the analysis of the accident data for the four-year period are shown in Table 3.12. From the table, it can be seen that almost 74 percent of the 9,183 materiel handling accidents occur in four location groupings. The locations are: 1) Storage Facilities (2,317 or 25 percent of the accidents); 2) Other Operational Facilities or Areas (1,784 or 19 percent); 3) Maintenance or Fabrication Facilities (1,644 or 18 percent); and 4) Service Facilities (1,082 or 12 percent). The other 26 percent or 2,356 accidents occurred in the other location groupings identified in Table 3.12.

Storage facilities accounted for 25 percent of the materiel handling accidents. There were 2,317 accidents; of these 2,016 or 87 percent involved civilians and 301 or 13 percent involved military personnel. The majority of these accidents or 1,439 of the 2,317 occurred in storage buildings. Civilians were involved in 1,258 of the 1,439 accidents or 87 percent and the remaining 181 accidents or 13 percent involved military personnel.

TABLE 3.10. Summary of the Number of Accidents by Major Army Command for the Period FY 1983-1986

Major Army Command	Number of Civilian Accidents	Number of Military Accidents	TOTAL by MACOM
Forces Command	1,171	783	1,954
US Army Europe	1,241	470	1,711
National Guard	400	1,017	1,417
Army Materiel Command	1,387	22	1,409
Training and Doctrine Command	607	146	753
Headquarters Department of the Army	631	24	655
Department of the Army Corp of Engineers	480	2	482
Health Services	263	43	306
US Army Information Systems Command	127	27	154
Western Command	94	25	119
8th ARMY	34	35	69
Military Traffic Management Command	54	0	54
US Army Strategic Defense Command	51	0	51
Military District of Washington	19	8	27
JAPAN	11	0	11
Intelligence and Security Command	2	7	9
Criminal Investigation Division Command	0	1	1
Not Identified	0	1	1
Total	6,572	2,611	9,183

TABLE 3.11. Summary of Total Accidents for Military Personnel Only by Major Army Command for the Periods, FY 1983-1986 and FY 1987-1988

Major Army Command	FY 1983-1986 Number of Accidents	FY 1983-1986 Percent of Total	FY 1987-1988 Number of Accidents	FY 1987-1988 Percent of Total	Total Accidents
Forces Command	783	30	341	31	1,124
US Army Europe	470	18	219	20	689
National Guard	1,017	38	346	32	1,363
Army Materiel Command	22	1	13	1	35
Training and Doctrine Command	146	6	68	6	214
Headquarters Department of the Army	24	1	13	1	37
Department of the Army Corp of Engineers	2	<1	0	0	2
Health Services	43	2	16	1	59
US Army Information Systems Command	27	1	11	1	38
Western Command	25	1	26	2	51
8th ARMY	35	1	19	2	54
Military Traffic Management Command	0	0	0	0	0
US Army Strategic Defense Command	0	0	0	0	0
Military District of Washington	8	<1	5	<1	13
JAPAN	0	0	0	0	0
Intelligence and Security Command	7	<1	6	1	13
Criminal Investigation Division Command	1	<1	0	0	1
Not Identified	1	<1	7	<1	8
Total	2,611		1,090		3,701

Of the 9,183 materiel handling accidents, 1,784 accidents or 19 percent of the accidents occurred in other operational facilities or areas. This location grouping includes office buildings, Army National Guard facilities and other miscellaneous areas not contained in the other location groupings. Thirty-four percent or 603 of these accidents occurred in office buildings and as expected primarily involved civilian employees. Civilians were involved in 86 percent or 516 of the accidents and military personnel were involved in 14 percent or 87 accidents. Sixteen percent or 279 accidents in the other operational facilities grouping occurred in National Guard facilities and involved only military personnel.

There were 1,644 accidents in maintenance and fabrication facilities. These accidents accounted for 18 percent of the 9,183 accidents. Of these 1,644 accidents, 65 percent or 1,073 accidents occurred in vehicle maintenance and engineering facilities. Of the 1,073 accidents, 739 occurred in vehicle maintenance areas, including 399 civilian and 340 military accidents. Of the 1,073 accidents, 334 occurred in engineering facilities. Ninety-six percent of these 334 accidents (320) involved civilians.

Of the 1,082 accidents that occurred in service facilities, 973 or 90 percent involved civilians. The facilities included in this location grouping include the commissary, dining areas, medical care facilities, and other facilities that individually accounted for less than 5 percent of the service facility accidents. Commissaries and dining areas accounted for approximately 61 percent of the accidents. More than 99 percent, or 448 of the 450 accidents that occurred in the commissary involved civilians. There were 206 accidents in dining facilities, of which, 151 involved civilians (59 percent) and 55 involved military personnel (41 percent).

An additional analysis was performed to compare the results of the military accidents for the four year analysis, i.e., FY 1983-1986 and the two-year analysis, i.e., FY 1987-1988. The comparison results are shown in Table 3.13. The percent of military accidents by location grouping changed little from FY 1983-1986 to FY 1987-88. Notable increases in the numbers of accidents within groupings, based on the percentage by location, were identified in designated training areas, outside storage areas, outdoors areas (standing bodies of water and sloped terrain), indoor recreational facilities, airports, rail yards and electric power plants. Decreases other than those identified previously were identified in crew served range areas, office buildings, storage buildings, outdoors areas (open terrain), and outdoor recreational facilities.

TABLE 3.12. Summary of the Number of Accidents by Physical Location for the Period FY 1983-1986

Physical Location	Number of Accidents Civilian	Military	Total	Percent by Physical Location	Percent of all Accidents
Storage Facilities					
Storage Buildings	1,258	181	1,439	62.1	
Outside Storage Area	222	61	283	12.2	
Not Elsewhere Classified	536	59	595	25.7	
Sub Total	2,016	301	2,317		25.2
Other Operational Facility or Area					
Office Building	516	87	603	33.8	
Army National Guard	39	240	279	15.6	
Others	113	33	146	8.2	
Not Elsewhere Classified	573	183	756	42.4	
Sub Total	1,241	543	1,784		19.4
Maintenance or Fabrication Facility					
Vehicle Maintenance	399	340	739	45.0	
Engineering Facility	320	14	334	20.3	
Aircraft Maintenance	75	25	100	6.1	
Others	68	4	72	4.4	
Not Elsewhere Classified	355	44	399	24.3	
Sub Total	1,217	427	1,644		17.9
Service Facilities					
Commissary	448	2	450	41.6	
Dining Facilities	151	55	206	19.0	
Medical Care Facility	169	26	195	18.0	
Others	153	14	167	15.4	
Not Elsewhere Classified	52	12	64	5.9	
Sub Total	973	109	1,082		11.8
Training Areas					
Designated Area	24	310	334	39.4	
Temporary Area	4	155	159	18.8	
Range-Crew Served Weapons	6	101	107	12.6	
Range-Small Arms	24	42	66	7.8	
Others	2	8	10	1.2	
Not Elsewhere Classified	31	141	172	20.3	
Sub Total	91	757	848		9.2
Travel Ways					
Parking Lot	119	51	170	40.2	
Roadway	72	56	128	30.3	
Aircraft Way	14	20	34	8.0	
Railroad or Yard	14	19	33	7.8	
Others	16	8	24	5.7	
Not Elsewhere Classified	28	6	34	8.0	
Sub Total	263	160	423		4.6
Housing Facilities					
Other Housing Facilities	67	120	187	48.2	
Family Housing	75	106	181	46.6	
Not Elsewhere Classified	16	4	20	5.2	
Sub Total	158	230	388		4.2
Sub Total for Page	5,959	2,527	8,486		

TABLE 3.12. Cont'd

Physical Location	Number of Accidents Civilian	Military	Total	Percent by Physical Location	Percent of All Accidents
Plants and Factories					
Ammo or Weapons Plant	172	3	175	52.4	
Heating Plant	38	0	38	11.4	
Printing Plant	24	0	24	7.2	
Others	26	1	27	8.1	
Not Elsewhere Classified	69	1	70	21.0	
Sub Total	329	5	334		3.6
Recreation or Entertainment Facilities					
Outdoor Facilities	48	13	61	44.2	
Indoor Facilities	45	9	54	39.1	
Not Elsewhere Classified	21	2	23	16.7	
Sub Total	114	24	138		1.5
Terrain and Water Locations					
Open Terrain	16	5	21	19.8	
Moving Bodies of Water	17	3	20	18.9	
Standing Bodies of Water	12	4	16	15.1	
Lake Shore or Beach	7	4	11	10.4	
Sloped Terrain	8	2	10	9.4	
Wooded Terrain	8	0	8	7.5	
Not Elsewhere Classified	15	5	20	18.9	
Sub Total	83	23	106		1.1
Freight or Passenger Terminals					
Port, Dock or Wharf	30	10	40	48.8	
Rail Station or Yard	12	4	16	19.5	
Airport or Airfield	5	7	12	14.6	
Others	3	0	3	3.7	
Not Elsewhere Classified	10	1	11	13.4	
Sub Total	60	22	82		<1
School Facilities					
Occupation Related School	2	6	8	40.0	
Dependent School	3	2	5	25.0	
Not Elsewhere Classified	7	0	7	35.0	
Sub Total	12	8	20		<1
Hobby Shop					
Woodworking Shop	8	0	8	50.0	
Other Shop	2	1	3	18.8	
Auto Shop	1	1	2	12.5	
Not Elsewhere Classified	3	0	3	18.8	
Sub Total	14	2	16		<1
Not Identified	1	0	1		
Sub Total from First Page	5,959	2,527	8,486		
TOTAL	6,572	2,611	9,183		

TABLE 3.13. Summary of the Number of Accidents by Physical Location for Military Personnel Only for the Period FY 1983-1988

Physical Location	No. of Accidents 4 Year	Percent by Location	No. of Accidents 2 Year	Percent by Location	No. of Accidents 6 Year	Percent by Physical Location	Percent of All Accidents
Training Areas							
Designated Area	310	41.0	170	51.5	480	44.2	
Temporary Area	155	20.5	73	22.1	228	21.0	
Range-Crew Served Weapons	101	13.3	20	6.1	121	11.1	
Range-Small Arms	42	5.5	14	4.2	56	5.2	
Others(a)	8	1.1	2	0.6	10	0.9	
Not Elsewhere Classified	141	18.6	51	15.5	192	17.7	
Sub Total	757	29	330	30	1,087		29
Other Operational Facility or Area							
Army National Guard	240	44.2	75	31.9	315	40.5	
Office Building	87	16.0	15	6.4	102	13.1	
Others(a)	33	6.1	10	4.3	43	5.5	
Not Elsewhere Classified	183	33.7	135	57.4	318	40.9	
Sub Total	543	21	235	22	778		21
Maintenance or Fabrication Facility							
Vehicle Maintenance	340	79.6	131	78.4	471	79.3	
Aircraft Facility	25	5.9	12	7.2	37	6.2	
Others(a)	18	4.2	1	0.6	19	3.2	
Not Elsewhere Classified	44	10.3	23	13.8	67	11.3	
Sub Total	427	16	167	15	594		16
Storage Facilities							
Storage Building	181	60.1	39	47.0	220	57.3	
Outside Storage Area	61	20.3	21	25.3	82	21.4	
Not Elsewhere Classified	59	19.6	23	27.7	82	21.4	
Sub Total	301	12	83	8	384		10
Housing Facilities							
Other Housing Facilities	120	52.2	63	47.4	183	50.4	
Family Housing	106	46.1	60	45.1	166	45.7	
Not Elsewhere Classified	4	1.7	10	7.5	14	3.9	
Sub Total	230	9	133	12	363		10
Travel Ways							
Parking Lot	51	31.9	27	36.0	78	33.2	
Roadway	56	35.0	21	28.0	77	32.8	
Railroad or Yard	19	11.9	6	8.0	25	10.6	
Aircraft Way	20	12.5	3	4.0	23	9.8	
Others(a)	8	5.0	1	1.3	9	3.8	
Not Elsewhere Classified	6	3.8	17	22.7	23	9.8	
Sub Total	160	6	75	7	235		6
Service Facilities							
Dining Facility	55	50.5	22	61.1	77	53.1	
Medical Care Facility	26	23.9	7	19.4	33	22.8	
Others(a)	16	14.7	3	8.3	19	13.1	
Not Elsewhere Classified	12	11.0	4	11.1	16	11.0	
Sub Total	109	4	36	3	145		4
Sub Total for Page	2,527		1,059		3,586		

TABLE 3.13. Cont'd

Physical Location	No. of Accidents 4 Year	Percent by Location	No. of Accidents 2 Year	Percent by Location	No. of Accidents 6 Year	Percent by Physical Location	Percent of All Accidents
Terrain and Water Locations							
Standing Bodies of Water	4	17.4	3	33.3	7	21.9	
Open Terrain	5	21.7	1	11.1	6	18.8	
Lake Shore or Beach	4	17.4	1	11.1	5	15.6	
Moving Bodies of Water	3	13.0	1	11.1	4	12.5	
Sloped Terrain	2	8.7	2	22.2	4	12.5	
Not Elsewhere Classified	5	21.7	1	11.1	6	18.8	
Sub Total	23	1	9	1	32		<1
Recreation or Entertainment Facilities							
Outdoor Facilities	13	54.2	4	40.0	17	50.0	
Indoor Facilities	9	37.5	5	50.0	14	41.2	
Not Elsewhere Classified	2	8.3	1	10.0	3	8.8	
Sub Total	24	1	10	1	34		<1
Freight or Passenger Terminals							
Port, Dock or Wharf	10	45.5	0	0.0	10	37.0	
Airport or Airfield	7	31.8	3	60.0	10	37.0	
Rail Station or Yard	4	18.2	2	40.0	6	22.2	
Not Elsewhere Classified	1	4.5	0	0.0	1	3.7	
Sub Total	22	1	5	<1	27		<1
School Facilities							
Occupation Related School	6	75.0	0	0.0	6	54.5	
Dependent School	2	25.0	1	33.3	3	27.3	
Not Elsewhere Classified	0	0	2	66.7	2	18.2	
Sub Total	8	<1	3	<1	11		<1
Plants and Factories							
Ammo or Weapons Plant	3	60.0	1	50.0	4	57.1	
Other Industrial Plants	1	20.0	0	0.0	1	14.3	
Electric Generating Plant	0	0	1	50.0	1	14.3	
Not Elsewhere Classified	1	20.0	0	0.0	1	14.3	
Sub Total	5	<1	2	<1	7		<1
Hobby Shop							
Auto Shop	1	50.0	1	100.0	2	66.7	
Other Shop	1	50.0	0	0.0	1	33.3	
Sub Total	2	<1	1	<1	3		<1
Not Identified	0		1		1		
Sub Total from First Page	2,527		1,059		3,586		
TOTAL	2,611		1,090		3,701		

3.12 VERIFICATION AND VALIDATION OF IN DEPTH ACCIDENT REPORT ANALYSIS

In order to evaluate whether the detailed analysis of problem areas (which utilized data from DA From 285-1) was truly representative of all materiel handling accidents, additional analysis sought to test those conclusions. A sample of DA Form 285 data was selected, stratified by materiel handling category for the FY 1983-1986 period. A verification/validation data base was developed containing roughly the same number of accidents for each year as were used in the original analysis. Accidents were selected in each of the four years were temporally spaced by choosing every *n*th accidents for each materiel handling category. *N* being chosen to approximate the number of accidents for each year available for the analysis of the DA Form 285-1 data. For example, there were 85 "Transportation" accidents in the DA Form 285-1 data, including those that were determined not to be materiel handling; therefore, 85 accidents in the DA Form 285 data for each year were selected for verification and validation.

The accident narrative data in the verification/validation data base were then reviewed to determine the frequency of occurrences of the problem areas identified in the in-depth accident and investigation reports, i.e., DA Form 285-1 data. The results of the evaluation (see Table 3.14) show that, for "Transportation," 87 percent (67/77) of the accidents involved the same problem areas identified in the DA 285-1 analysis. Similarly, 81 percent (51/63) of the accidents for "Loading or Unloading" and 80 percent (8/10) of the accidents for the "Other Categories" involved the same problem areas.

An analysis of the "Transportation" accidents indicated that the problem areas "Improper Techniques" and "Handling Excessive Loads" represented the majority of the accidents. The percentages of the total number of accidents for these problem areas in the DA 285 data are slightly less (27 percent and 25 percent, respectively) than the percentages found in the DA 285-1 data (31 percent and 29 percent, respectively). One problem area identified in the DA 285 data not identified in the DA 285-1 "Transportation" accidents was "Climbing On or Off Vehicles." This problem area was identified in the "Loading or Unloading" category. Another problem area, "Trips, Slips or Falls," showed a marked increase in the DA 285 data (11 percent) when compared to the DA 285-1 (3 percent).

The analysis of the "Loading or Unloading" accidents was similar to the "Transportation" accidents. That is, the problem areas "Improper Techniques" and "Handling Excessive Loads" represented the majority of the accidents. There was also an increase in the number "Trips, Slips or Falls" accidents for "Loading and Unloading".

Of the accidents in the DA 285 data for the "Other Categories", there was one accident each for the problem areas "Improper Techniques" and "Handling Excessive Loads" (Team Activities). There were no accidents identified in the DA 285-1 data with the same problem areas. The remaining problem areas agree with the DA 285-1 accident analysis.

TABLE 3.14. Verification of Identified Problem Areas

Problem Area	Transportation Frequency	Transportation Percent Total	Average Frequency	Average Percent Total
Handling Excessive Loads				
Individual Activities				
Lift	22	29	16	25
Carry	4	5	2	3
Lateral	2	3	3	5
Team Activities				
Lift	5	6	3	5
Carry	0	0	2	3
Improper Techniques				
Lift	24	31	17	27
Carry	6	8	1	2
Lateral	3	4	2	3
Unsecured Loads	7	9	6	9
Climbing On/Off Vehicles	0	0	4	6
Equipment Usage	1	1	0	0
Materiel Failure	1	1	1	2
Singular Problem Areas				
Trips, Slips or Falls	2	3	7	11
Cutting Equipment	0	0	0	0
Total	77		64	

Problem Area	Loading or Unloading Frequency	Loading or Unloading Percent Total	Average Frequency	Average Percent Total
Handling Excessive Loads				
Individual Activities				
Lift	13	21	10	20
Lateral	2	3	2	4
Team Activities				
Lift	5	8	4	8
Improper Techniques				
Lift	15	24	11	22
Lateral	2	3	0	0
Unsecured Loads	7	11	6	12
Climbing On/Off Vehicles	9	14	7	14
Equipment Usage	4	6	3	6
Materiel Failure	3	5	0	0
Environment	1	2	0	0
Singular Problem Areas				
Trips, Slips or Falls	2	3	8	16
Total	63		51	

Problem Area	Other Categories Frequency	Other Categories Percent Total	Average Frequency	Average Percent Total
Handling Excessive Loads				
Individual Activities				
Lift	4	40	0	0
Lateral	1	10	0	0
Team Activities				
Lift	0	0	1	13
Improper Techniques				
Lift	0	0	1	13
Unsecured Loads	1	10	2	25
Equipment Usage	0	0	1	13
Environment	1	10	0	0
Singular Problem Areas				
Trips, Slips or Falls	2	20	3	38
Cutting Equipment	1	10	0	0
Total	10		8	

In summary, the problem areas identified in the analysis of the in depth accident reports are representative of the accidents contained in the ASMIS database. With the exception of the problem area "Trips, Slips or Falls" and individuals lifting "Excessive Loads," the percentage of accidents for the DA 285 and DA 285-1 varied by one to three percentage points.

3.13 FIELD VERIFICATION OF THE MATERIEL HANDLING ACCIDENT REPORT ANALYSIS

A field study was conducted at three Army installations having a variety of materiel handling tasks. The site visits were coordinated by the USASC and the host installation safety offices. A member of the USASC's Installation Safety Branch accompanied PNL staff members on the site visits. These sites included a FORSCOM installation, a TRADOC installation and an AMC Depot. The purpose of this field study was to verify the problem areas and system inadequacies identified by analysis of the materiel handling accident reports, and to identify other problem areas and system inadequacies not previously noted.

The civilian locations visited included several maintenance and storage facilities, and two commissaries. The military locations visited included a large storage facility, an ammunition shipping/receiving site and one outdoor operational area. No military training or vehicle maintenance areas were visited.

To provide a consistent format for feedback regarding materiel handling problems, the questionnaire shown in Appendix A was developed to elicit responses regarding problem areas and system inadequacies. A total of 101 responses were obtained. This included 22 military responses and 79 civilian responses which generally reflected the proportions of military and civilian activities which were visited. The field study also included opportunities for discussion with workers in addition to the questionnaires.

3.13.1 Worker Identification of Materiel Handling Problem Areas

Materiel handling problem areas identified by military and civilian personnel in the field study are tabulated in Table 3.15 by the percent of total responses that fell in each materiel handling problem category. The percentage of materiel handling accidents from Table 3.3 that resulted from each problem area is provided in the last column for comparison.

The questionnaire was designed to permit each person to list up to seven separate problem areas. The 22 military personnel provided 37 problem area responses, while the 79 civilian personnel provided 134 problem area responses. In 27 percent of the questionnaires, no problem areas were identified.

TABLE 3.15. Workers' Views of Materiel Handling Problem Areas

	Military	Civilians	Total Survey	DA Form 285-1
Number of questionnaires/reports	(n=22)	(n=79)	(n=101)	(n=150)
Problem area responses	37	134	171	150
Excessive Loads	8.1%	13.4%	12.3%	38.7%
Improper Technique	27.0	33.6	32.2	33.3
Unsecured Loads	8.1	6.7	7.0	10.0
Climbing on or off vehicles	0	0	0	6.0
Equipment Usage	8.1	8.2	8.2	2.7
Materiel Failure	21.6	8.2	11.1	2.7
Environment	2.7	3.7	3.5	1.3
Singular Problem Areas	24.3	26.2	25.7	5.3
Congested work areas*	(8.1%)	(17.2%)	(15.2%)	--

* Congested Work Areas is a subset of the Singular Problem Area category.

There was agreement between Army civilian and military workers regarding the top materiel handling problem as indicated by the frequency at which this problem area was identified. In both the civilian and military responses, improper technique was the most frequently identified problem area leading to materiel handling mishaps. This accounted for about a third of the responses, which was the percentage of accidents judged to be due to improper techniques in Table 3.3.

The next most frequent response was congested work areas. This problem area was not identified in the review of 285-1 accident reports because it was not viewed as the direct cause of materiel handling mishaps by accident investigators. The third most frequent materiel handling problem area was excessive loads. This was the leading problem area noted in the review of 285-1 Army accident reports.

This analysis assumes that the frequency of responses reflects the level of awareness or concern for the listed problem areas. However, it is also useful to look at the problem area of the greatest concern by the individual worker.

The questionnaire requested that problem areas be listed with most serious problem area first. Improper technique was listed as the most serious problem area in 30 percent of the 74 questionnaires that specified a problem area, followed by materiel failure and excessive loads which were cited in 16 and 15 percent of these questionnaires respectively. Figure 3.2 shows how frequently each problem area was identified as being most serious.

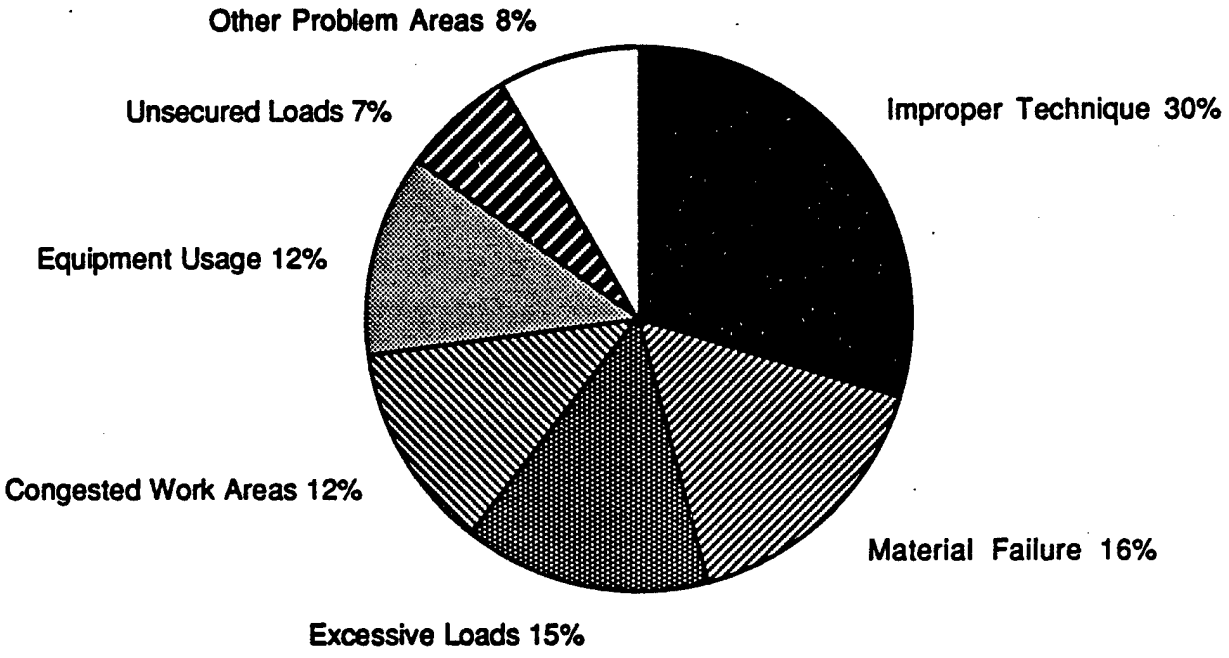


FIGURE 3.2. Problem Areas Workers Identified as Being Most Serious

3.13.2 Worker Poll of Materiel Handling System Inadequacies

The survey also gathered input on system inadequacies. Personnel were asked to indicate whether each potential system inadequacy had an effect on the safe accomplishment of materiel handling activities. They provided their responses by indicating whether they believed that the specified area was **not a problem, a slight problem, a moderate problem, or a serious problem.** Table 3.1.4 summarizes the results of this portion of the questionnaire. The average rating, R, and the number of moderate and serious problem responses for each potential problem area are provided for military, civilian personnel and their combined total. The last column provides the percentage of 285-1 accident reports from Table 3.4 that were judged to be due to each system inadequacy for comparison.

The system inadequacy that had the highest average rating was inadequate or unavailable materiel handling equipment. About 40 percent of the respondents rated this a moderate or serious problem. Lack of sufficient personnel to do the work received the second highest rating with over 30 percent of the respondents indicating that this was a moderate or serious problem. Only about four percent of the 285-1 accident reports were attributed to these two system inadequacies. Personal factors such as inattention or overconfidence which had been attributed to 44 percent of the accidents was noted by only 10 percent of the respondents as being a moderate or serious problem. Military personnel rated all problem areas as being more serious than did the civilian respondents.

TABLE 3.16. Materiel Handling System Inadequacies Rated by Workers

Rated on a scale from 1 "not a problem" to 4 "a serious problem."

Number of questionnaires/reports	Military (n=22)		Civilians (n=79)		Total Survey (n=101)		DA Form 285-1 (n=124)
	$\bar{R}$	% Mod/Ser	$\bar{R}$	% Mod/Ser	$\bar{R}$	% Mod/Ser	% of accidents attributed to
Inadequate procedures	2.05	22.7	1.22	3.8%	1.40	7.9%	2.4%
Lack of training	2.27	36.4	1.41	6.3	1.59	12.9	4.8
Insufficient personnel	2.91	4.5	1.85	20.3	2.08	30.7	*
MHE inadequate or unavailable	3.09	68.2	1.96	31.6	2.21	39.6	*
Inadequate supervision	1.68	9.1	1.24	7.6	1.34	7.9	12.9
Inattention or overconfidence	2.00	27.3	1.41	7.6	1.53	11.9	44.4
Work overload	2.55	40.9	1.43	12.7	1.67	18.8	*
Lack of motivation	2.14	36.4	1.37	8.9	1.53	16.8	15.3
Inexperience	1.81	13.6	1.19	5.1	1.32	6.9	8.9

$\bar{R}$ is the average rating for the system inadequacy.
% Mod/Ser is the percentage of responses that indicated that the specified system inadequacy was a moderate or serious problem.
* Inadequate services or facilities, and inadequate maintenance were the primary system inadequacies in only 4 percent of the accident reports reviewed.

3.13.3 Review of 1989 Federal Employees' Compensation Act Cases

At each site visited, a review of civilian injuries cases in 1989 showed a surprising consistency in the percentage of claims associated with materiel handling activities in spite of the differences in the missions of these three locations. Materiel handling injuries accounted for 34-35 percent of the injuries at all three locations. Overall, materiel handling injuries represented 34 percent of the 539 cases reviewed.

Back injuries accounted for about half (50.3%) of these materiel handling cases. Back injuries represented over half (57.0%) of the lost time materiel handling claims. This is significantly higher than the 32.8 percent level of back injuries noted in the FY 83-86 DA Form 285-1 materiel handling accident data shown in Figure 3.3. However, that data was restricted to cases with 20 or more days lost time.

The National Safety Council reported that 32 percent of the disabling injuries and 42 percent of compensation costs that occurred in 1984 involved the body trunk. The trunk of the body was involved in 59 percent of the FY 83-86 285-1 disabling accidents (accidents with a minimum of 20 lost workdays) shown in Figure 3.3 and 76 percent of all disabling accidents reviewed during the field verification study.

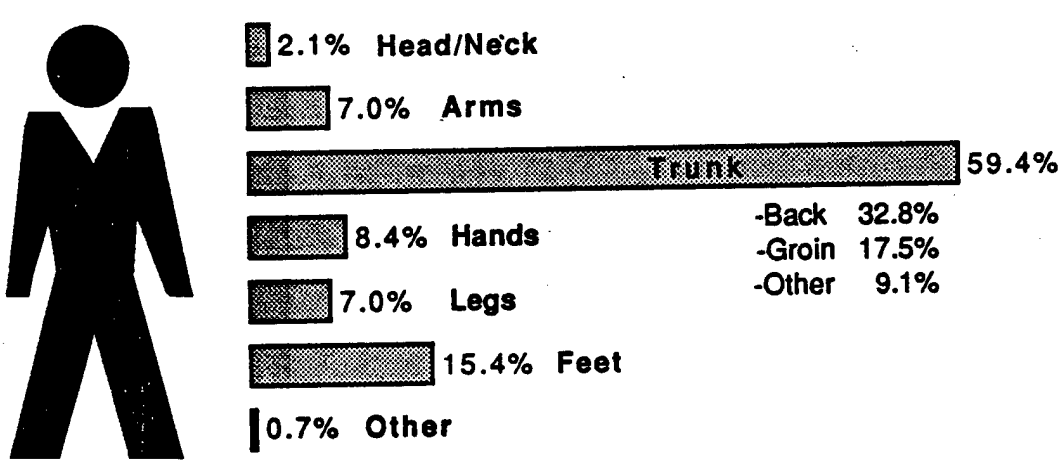


FIGURE 3.3. Part of Body Injured, FY 1983-1986 (DA Form 285-1)

(n=143 cases where injured body part is identified)

3.13.4 Field Study Observations Regarding Materiel Handling Safety

This section provides an anecdotal summary of observations from the field verification visits. It is not intended to be a critique of operations, but rather a snapshot of impressions that relate to the overall state of materiel handling safety.

3.13.4.1 Materiel Handling Work Practices

Two materiel handling mishaps occurred during site visits. A forklift truck carrying pallets stacked three high spilled the load off the loading dock onto the railroad tracks while making a turn. A collision of stock selector units is described below.

Other work practices observed could have resulted in mishaps. In one case, a 4000 pound forklift truck had gone off the edge of a paved surface and become stuck. A 10,000 rough terrain forklift was being used to lift the smaller forklift and place it back onto the pavement. The driver of the smaller forklift was still seated on his unit as the larger forklift was lifting and straining to push its forks under the smaller unit. The operator of the smaller unit immediately dismounted as we approached. In the second case at a commissary, we observed operators of stock selectors not using required safety belts and tether lines. The tether strap which was connected to an inertial reel on the overhead protective cage had been tied up out of the way. Even after discussing the use of such safety equipment, the operator did not use it. This same safety equipment was being used routinely at another commissary that was visited.

One civilian shipping and receiving area had three forklifts fall off of loading docks in the past five years. A military shipping and receiving area had two forklifts fall off of docks in the last two years. One of these accidents resulted in a fatality.

All forklift operators were aware that horns should be sounded when approaching corners or blind intersections. Operators who were not aware of our presence did not always sound their horn as required. At one commissary warehouse, where almost every aisle had blind intersections, two stock selectors collided during our visit. Designers of such vehicles need to plan for maintenance tasks by providing lift lugs or keys on heavy internal components and designs that permit standard hoists or cranes to be used for lifting tasks.

Maintenance shops still have some operations in which personnel feel they must work on loads suspended from cranes. Communication and enforcement of safety expectations by supervisors was primarily responsible for this difference in attitudes.When mating up engine and transmission cases, mechanics worked immediately adjacent to the suspended load, since there were no fixtures for this specific operation. A recent sling failure in one shop had caused a serious arm injury to a mechanic who was guiding a component into position. No head protection was used in the maintenance shops where overhead jib and bridge cranes were used.

There were some maintenance tasks inside of armored vehicles such as replacing batteries and other heavy components which the use of existing materiel handling equipment is not feasible. Such manual materiel handling is complicated by the cramped work space where safe lifting guidelines and team lifting cannot be readily applied.

Shipping production quotas for work areas which had been used at the depot had been discontinued since it put too much pressure on workers. Several questionnaires indicated that excessive work demands were a potential cause of accidents.

3.13.4.2 Materiel Handling Work Procedures

Most workers indicated that Standing Operating Procedures (SOPs) and verbal instructions provided their materiel handling guidance. SOPs reviewed varied from providing no safety guidance, to providing specific instructions regarding forklift operation. One site had an installation pamphlet on safe practices for operation of forklifts and tractors. No SOPs that we reviewed covered safe lifting practices for manual materiel handling. SOPs that exist were normally posted in the work place or available in a notebook.

There were generally SOPs available for the receipt, storage and shipment of hazardous materiels and the use of personal protective equipment.

None of the three sites were familiar with Department of Defense DODI 4145.19-R-1 Storage and Materiels Handling which contains guidance on mechanized and manual materiel handling. Similarly, DA Pamphlet 385-8 Safety

Back Injury Prevention was also not referenced as a source of manual materiel handling procedures.

3.13.4.3 Materiel Handling Training

One soldier who was trying to operate a 10,000 pound rough terrain forklift had to ask another soldier how to operate it as we were standing nearby. At one time, there had been a maintenance team that conducted forklift training at this installation. However, that unit had been dissolved and the responsibility for training and licensing had fallen on the materiel handling equipment maintenance shop. None of the four individuals in that shop had had any forklift safety training. Military personnel at the same installation indicated that any licensed operator, E-7 or above could train and license other military personnel.

The depot visited had a specific forklift training program with classroom instruction, and written and driving tests.

Training for manual materiel handling was reported by workers at two installations. In both cases, it was provided by the Health Service Command (HSC) either from the local Medical Activity (MEDDAC) or from off post. The course on proper lifting procedures and back injury preventive measures at one installation was provided by the physical therapist who had received a request to conduct such training and had a personal interest. He indicated that he had to develop his own course since he could not find good training materials within the Army. The second course was a classroom course that was conducted by a group from another installation. Unit safety training classes provided by installation safety offices did not address manual materiel handling in any depth.

3.13.4.4 Materiel Handling Equipment

The site visits revealed a much higher degree of mechanized materiel handling than would be suspected from review of the materiel handling accidents. Such mechanized materiel handling equipment included unpowered equipment such as pallet jacks, hand trucks, carts and gravity roller conveyors. Powered equipment included normal and "sidewinder" fork lift trucks; stock selectors; mule trucks pulling freight carts; cranes and hoists; powered roller conveyors; carousel bin systems; aircraft load leveling platforms; and special pallet transport vehicles with roller conveyor beds.

The few accidents in the 150 DA Form 285-1 reports that involved mechanized materiel handling equipment were often actually manual handling incidental to the use of such equipment. This does not mean that there are no accidents involving mechanized materiel handling equipment as can be seen from the forklift cases noted above. It is likely that the lack of mechanized materiel handling accident data is due to the practice of classifying accidents by primary activity category only. This would typically exclude forklift accidents since they would be classified as motorized vehicle accidents, rather than as materiel handling accidents.

We talked to an industrial engineer who had been instrumental in designing a number of special fixtures and maintenance stands in the maintenance shops that had helped to reduce the risks associated with materiel handling during maintenance operations. Some maintenance stands used for combat equipment were developed by the contractor who designed the equipment. However, several maintenance operations inside the hulls of combat vehicles, where typical materiel handling equipment is not feasible, require manual handling of heavy components and have caused injuries in the past. It appeared that special hoists could be designed to facilitate this work.

In some instances, the supply shops had also designed special racks to facilitate placement and recovery of heavy components. Some locations had heavy items stored on higher racks which made their retrieval difficult and sometimes hazardous. This was the case for truck tires stored on overhead racks in a maintenance warehouse and large bags of dog food stacked on pallets on the top of storage racks about 20 feet above the aisle.

While occupational health and safety inspections are routinely conducted at installations, the safety offices visited said they did not specifically conduct materiel handling safety inspections per se.

Most of the older 4000 pound electric forklifts used in warehouses were 15 to 20 years old. At one site, normal quarterly preventative maintenance was not possible due to manpower limitations. There were four mechanics to service 352 pieces of motorized materiel handling equipment. However, there was little indication that maintenance problems contributed to accidents from the accident data. One mechanic reported that forklifts tend to fail safe or impending failures are detectible, e.g., leaks of hydraulic fluid indicate damaged fittings or hoses. One forklift operator reported having experienced a near miss involving sudden brake failure of a forklift truck. Again the lack of accident data from motorized materiel handling equipment may have obscured this problem.

Automated carts that follow a line in the floor were sitting idle at the depot due to the high maintenance required to keep them operational.

Older warehouse forklifts often do not have any lights to make them more visible. The depot was the only site that required a rotating beacon light on all motorized materiel handling equipment. All forklifts are equipped with horns. Only large rough terrain forklifts were equipped with audible backup signals.

Large "triwall" cardboard boxes on pallets (approximately 48"x48"x42") posed special problems to personnel who must unload these boxes. Often heavy items or parcels were placed on the bottom to minimize the potential for damage during shipping. Unloading the triwall box forces the worker to bend from the waist and stretch to lift these items out over the wall. At one location the lady unloading such items had to use a ladder to climb into the box to unload it. With very heavy items, the workers simply cut the triwall boxes open rather than save them for reuse. At the depot, we observed a battery

operated piece of equipment used to tilt these large boxes to facilitate loading and unloading. Such equipment was not found at the TRADOC or FORSCOM facilities.

In one maintenance shop, slings and spreaders were located on the floor throughout the shop rather than being stored up out of the way to prevent damage.

3.13.4.5 Materiel Handling Facilities

Most shipping and receiving facilities were laid out to permit a smooth flow of goods through the warehouse. However, in one World War II vintage building converted into a shipping and receiving warehouse, the shipments were received and dispatched from the same end of the facility and through the same doorway to the same loading dock.

In several locations, aisleways were not marked to separate pedestrian traffic from mechanized traffic. In the depot visited, walkways were marked but due to the high number of visitors, workers reported that they must be vigilant for visitors throughout the work area.

Warehouses typically have blind corners at the ends of aisles. The administrative control is the use of the horn prior to reaching the intersection to warn other drivers in the vicinity. There was no evidence that mirrors had been used to provide visual information to drivers. There was some suggestion that mirrors would soon be broken by loads. Lighting in one location was very poor due to energy conservation measures, thus adding to the visibility problem.

A special hydraulic unit was used to lower aircraft pallets as they were loaded to allow the worker to adjust the working height for personal comfort. This is a very useful device since pallets are often loaded to a height of five or six feet and secured with shrink wrap and a webbed netting which is cinched down around the load. The one drawback is that as the pallet is loaded, the corners of the unit become empty holes in which the worker concentrating on the pallet may inadvertently fall. One recent incident of this nature was reported by a worker in this area.

One warehouse had no roof over the loading docks and others reported problems of rain and snow on exterior loading docks. Traction for the hard rubber tires of industrial forklifts was greatly reduced under these circumstances. There was no indication whether such environmental conditions contributed to the cases of forklifts falling off loading docks that were reported. Newer buildings have docks which provide a seal between the rear of the truck and the building, thus eliminating the problem of wet or icy surfaces, and reducing losses of tempered air. This also prohibits entry of birds and rodents into commissary warehouses. Workers at one warehouse stated that they had had potholes in their loading dock which had taken months to get repaired, even though they had caused damage to freight falling from loaded pallets as the forklift struck the potholes.

Hydraulic truck unloading ramps which project back inside buildings were reported to be tripping and possible forklift tipping hazards if workers or forklift trucks strike the ramp from the side while it is elevated. This continued to be a problem even though the edges of the ramps had been painted yellow for visibility. Such ramps were often left elevated when not in use.

One materiel handling activity that was reported to be a significant problem area involved the incidence of carpal tunnel syndrome among checkers at the two commissaries visited. There were three cases of carpal tunnel syndrome among commissary workers at one installation over the first six months of 1989. No cases were reported for the second installation during that same period. Checkers pick up thousands of items each day of various weights and rotate each item over the laser scanner. One commissary complicated this with a convoluted checkout system in which all groceries had to be moved in an "S" pattern around the checker during the checkout process.

When trucks are over a foot different in elevation from the loading dock, forklift trucks and palletized loads are jarred where the floor meets the angle of the ramp and where the ramp meets the floor of the truck. While watching the unloading of a truck, one box was dislodged from the top of a palletized load when the forklift hit the change in slope between the ramp and the floor.

One factor associated with congested work places was housekeeping. One area had pieces of broken pallets, banding and cardboard lying on the floor. Housekeeping was generally good at most locations.

3.13.4.6 Materiel Handling Personnel

The principle difficulty in conducting a field study of materiel handling accidents is that everyone to some extent is a materiel handler. The field verification study targeted specific military MOSs and civilian worker families for special attention. It was evident that even in the locations where we expected to find these workers, that there was still a diversity of other workers who could be at risk. This prompted us to go to question the validity of using frequencies of accidents for establishing priorities.

The Defense Manpower Data Center (DMDC) provided manpower levels for a limited sample of the MOSs, civilian worker families and the MACOMs that permitted us to calculate accident incidence rates (number of accidents per 100 staff years). The September 1985 manpower levels were used. DMDC indicated that this was representative of average manpower levels during the FY 1983-1986 period since there had been little change.

First we examined all MACOMs that had experienced over 100 materiel handling accidents during the FY 83-86 period. Table 3.17 shows how the priorities change based on incidence rates when compared to the order based on accident frequency in Table 3.10. The three MACOMs that had experienced the highest number of materiel handling accidents actually have had fewer accidents per capita than have the top three MACOMs shown in Table 3.17. Incidence rates for the total Army (Active Army and National Guard) are provided at the bottom of the table to provide an indication of whether a particular MACOM is above or below the Army average incidence rate.

TABLE 3.17 Materiel Handling Accident Incidence Rates For FY 1983-1986 by MACOM

Table 3.10 FY 83-86 Civ. Acc.	FY 83-86 Civ. Ave. Inc. Rate	Table 3.10 FY 83-86 Mil. Acc.	FY 83-86 Mil. Ave. Inc. Rate	Table 3.10 FY 83-86 Tot. MH Acc.	FY 83-86 Total Ave. Inc. Rate	FY 83-86 MACOM Rank by Inc. Rate
631	8.917	24	4.444	655	8.600	HQDA
1387	4.497	22	3.595	1409	4.480	AMC
400	0.384	1017	0.424*	1417	0.412	NG
480	0.258	2	0.169	482	0.257	COE
1241	1.610	470	0.065	1711	0.214	USAEUR
94	0.849	25	0.045	119	0.177	WESTCOM
263	0.265	43	0.052	306	0.168	HSC
1171	0.650	783	0.077	1954	0.164	FORSCOM
127	0.391	27	0.033	154	0.135	INSCOM
607	0.344	146	0.0347	53	0.125	TRADOC
6589	0.401	2637	0.090	9226	0.202	TOTAL ARMY

* This figure is based on the National Guard military work year being approximately 15% of full work year.

The lost workday case injury incidence rates for the top seven plus three additional MOSs and civilian worker families were calculated as a check on priorities assumed from frequency data in Tables 3.6 and 3.8. The changes in order are shown in Table 3.18 and 3.19. The MOS with the highest incidence rate of the ten MOSs reviewed was crane operators which was ranked number 45 by accident frequency. Warehouse workers remained the occupation having the highest materiel handling accident risk of the ten civilian worker families reviewed, but relative ranking changed for other worker families.

TABLE 3.18 Comparison of Materiel Handling Injury Incident Rates For Ten Military Occupational Specialties for the Period FY 1983-1986

Military Occupational Specialty	FY 83-86 Injuries	Material Handling Incidence Rate
Crane Operator	12	0.115
Combat Engineer	145	0.110
Cannon Crew Member	198	0.107
Unit Supply Specialist	133	0.096
Food Service Specialist	126	0.083
Motor Transport Operator	133	0.083
Wire Systems Installer	29	0.080
Light Wheel Vehicle Mechanic	120	0.076
Infantryman	125	0.032
Medical Specialist	19	0.019

TABLE 3.19 Comparison of Materiel Handling Injury Incidence Rates for Ten Civilian Worker Families for the Period FY 1983-1986

Civilian Worker Family	FY 83-86 Injuries	Materiel Handling Incidence Rate
Warehouse Worker	757	2.33
Packer	121	2.09
Crane Operator	29	1.39
Laborer	173	1.29
Materiels Expediter	23	1.01
Electrical Cable Splicer	25	0.92
Motor Vehicle Operator	141	0.83
Maintenance Mechanic	110	0.82
Heavy Equipment Mechanic	223	0.66
Supply Technician	140	0.28

There were some complaints of personnel not being physically capable of safely performing manual materiel handling tasks. One complaint indicated that individuals who were currently receiving compensation for prior back injuries were hired to work in jobs that had significant lifting requirements. This was confirmed with the personnel office that indicated that such decisions were ultimately made by the physician. A second problem indicated that efficiency efforts in determining the size of work force for the "most effective operation" had resulted in reassignment of civilian wage grade personnel into other positions at the same grade regardless of changes in physical requirements.

One manager complained of civilian personnel who "abuse the system." This comment was made in reference to the compensation system and the difficulty of truly assessing the severity of back strains. Followup discussions with medical personnel indicate that there have been similar cases for military personnel.

One group of civilian workers complained of communication problems. They indicated that if an accident occurred, the worker was automatically considered to be at fault regardless of the circumstances. The supervisors attributed this to the format of the compensation report forms used. After suffering a minor laceration while unpacking a cardboard container, a worker informed his supervisor that another work group was using staples to affix paperwork to the containers rather than tape as required. Even though the supervisor contacted the manager in the group responsible, he failed to close the loop and inform his crew or have them watch to ensure that the problem was resolved. As a result, the problem continued and the workers had not told their supervisor because they felt that it would not accomplish anything. A third problem noted at the depot was lack of coordination of workflow between work groups based on the priority of shipments. This resulted in work loads alternating between crisis and boredom levels. This had been relieved to some extent by a establishing a controller for loads of goods between warehouses and shipping areas.

3.13.4.7 Medical Surveillance and Hiring Practices

The preemployment medical examination is the principle screening tool to ensure that job applicants are physically able to efficiently perform the essential functions of the position without hazard to themselves or others. The Military Entrance Processing Station (MEPS) physicals serve the same purpose. One physician at the civilian health clinic stated that the screening tools available for detection and assessment of preexisting back injuries were extremely limited. He generally used only range of motion testing for his determination. X-rays were not routinely used due to the cost.

Job descriptions under the Section, "Statement of Duties and Responsibilities," describe the loads which are handled:

> "The work is strenuous, requiring frequent lifting and carrying of items weighing up to 50 pounds and often exerting similar effort in the pushing, pulling, turning and positioning of items. The assistance of other workers or lifting devices is available to move and lift heavier items.
>
> Requires frequent lifting of materiels weighing up to 70 pounds and may weigh over 70 pounds.
>
> Frequently lifts and carries heavy items."

Such statements do not take into account such critical factors as frequency of the lift, size of the load, nor height of the lift.

One physician said that in order to maximize readiness and performance, physical standards have been raised to maintain an Army of soldiers in top physical condition. There is no room for soldiers with physical limitations, even though there are many jobs that they could perform. Instead, soldiers who have received various degrees of disability in the service have been boarded out of the Army in increasing numbers during the last two years with increasing separation costs.

In conclusion, the analysis of the DA Form 285-1 data and the additional analyses performed using the ASMIS database indicate that the majority of the materiel handling accidents (approximately 70 percent of the total materiel handling accidents for the four year period) involve civilian workers. Over 50 percent of the civilian accidents were identified in the "Transportation" category. This is an area that should be investigated routinely and brought to the attention of the Army managers responsible for such operations. In industry, active materiel handling training programs have been proposed by DuPont Safety Services with an estimated overall accident reduction of 37 percent for a five-year period. A 37 percent reduction in the numbers of materiel handling accidents to civilians would represent reductions of 2,300 accidents, 23,164 days lost, and $3,218,360 injury costs over a four-year period comparable to that analyzed in this report.

4.0 DISCUSSION AND CONCLUSIONS

This section discusses the results of the materiel handling accident data analyses. Materiel handling was divided into three categories. The three categories are: 1) Transportation - includes transporting, moving and delivering materiel or personnel; 2) Loading or Unloading - includes loading or unloading activities at fixed facilities (i.e., warehouses) or away from fixed facilities (i.e., transport or delivery vehicles); and 3) Other Categories - includes inventorying, packing, palletizing, rigging, withdrawing, and marking.

Analyses were performed using the data that were reported on DA Form 285-1's and the data contained in the ASMIS database, which is developed from DA Form 285 accident reports. The DA Form 285-1 accident reports, developed by Army safety professionals for FY 1986, identifing the accident cause, the system inadequacies in the Army system and the needed corrective measures. Accident data for civilian and military personnel contained in the ASMIS database were analyzed for the period, FY 1983-1986. Accident data were also analyzed for military personnel only for the period FY 1987-1988.

The following subsections discuss the analyses of civilian and military personnel materiel handling accidents using the data contained in the ASMIS database and the data reported on the DA Form 285-1 accident reports.

4.1 DISCUSSION OF ASMIS ACCIDENT DATA ANALYSES

The ASMIS accident data were analyzed to determine the magnitude of the materiel handling accidents. For a four-year period, FY 1983-1986, there were 9,183 materiel handling accidents involving civilian and military personnel. These accidents accounted for 9,226 injuries, 99,592 days lost and total costs of $18,849,955. The accident data contained in ASMIS were analyzed with respect to: 1) Materiel handling category; 2) Civilian or Military personnel; 3) Worker family or MOS; 4) MACOM; and 5) Accident location.

For the four-year period, approximately 48 percent of the 9,183 materiel handling accidents were categorized as "Transportation" accidents. The category called "Loading or Unloading" accounted for 33 percent of the materiel handling accidents. The third category of materiel handlers called "Other Categories" accounted for approximately 19 percent of the accidents.

Military personnel were involved in 28 percent of all the accidents. Thirty-nine percent of the military accidents were "Transportation" accidents, 47 percent were "Loading or Unloading" and 15 percent were included in the category called "Other Categories." The analysis of military accidents for the two-year period, FY 1987-1988, indicated that, as in the previous four-year period, the majority of the accidents involving military personnel occurred during "Loading or Unloading." A comparison of the accident data for the two periods indicated that the percentage of "Loading

or Unloading" accidents and the accidents that were categorized in the "Other Categories" remained relatively constant. However, there was an increase of 8 percent in percentage of the "Transportation" accidents.

The analysis of the accident data for the four-year period indicate that 37 percent of the materiel handling injuries occurred in 3 percent or 7 of the 273 enlisted MOS's identified in the ASMIS database. The seven enlisted MOS's, ranked in descending order, are:

- Cannon Crewmembers
- Combat Engineers
- Motor Transport Operators
- Unit Supply Specialists
- Food Service Specialists
- Infantrymen
- Light Wheel Vehicle Mechanics

The analysis of the military injuries for the two-year period indicated that these seven MOS's continue to be high injury producing occupations. However, for the two-year period, based on the number of injuries, Food Service Specialists, Canon Crewmembers and Infantrymen ranked one, two, and three.

A similar analysis was performed on the wage-grade and general-schedule civilian employees accidents identified in the ASMIS database. This analysis indicated that 76 percent of the injuries occurred in 5 percent or 7 of the 535 civilian worker families identified. This includes 178 general schedule and 357 wage grade worker categories. The seven civilian worker families by worker classification are:

- General Schedule Employees
  - Supply Technicians
- Wage Grade Employees
  - Warehouse Workers
  - Heavy Equipment Mechanics
  - Laborers
  - Motor Vehicle Operators
  - Packers
  - Maintenance Mechanics

The accident data contained in the ASMIS database was also analyzed with respect to accident location. This includes MACOM's and the physical locations where accidents have occurred. These were evaluated for both military and civilian accidents for the four-year period. Seventy-one percent of the accidents occurred at four MACOM's. With the exception of the National Guard most of the accidents at each of the following MACOM's involved civilian employees.

- Forces Command
- US Army Europe
- National Guard
- Army Materiel Command

The analysis of the military accidents for the two-year period did not indicate any appreciable change in the percentage of the total accidents at each of these MACOM's.

For the four-year period 74 percent of military and civilian accidents occurred at four location categories. The numbers of accidents at each of these categories accounted for more than 10 percent of all the accidents. The following is a list (ranked by percent of total accidents) of the four categories and the facility or area most often identified in the accident data.

- Storage Facilities
  - Storage Buildings
- Other Operational Facilities or Areas
  - Office Buildings
- Maintenance or Fabrication Facilities
  - Vehicle Maintenance Facilities
- Service Facilities
  - Commissary

A similar analysis of the accident locations was performed for military personnel only for the six-year period. There were four facility categories identified in the accident data that accounted for more than 10 percent of all the military accidents. These are listed below and are also ranked by percent of total accidents.

- Training Areas
  - Designated Training Areas
- Other Operational Facilities or Areas
  - Army National Guard
- Maintenance or Fabrication Facilities
  - Vehicle Maintenance Facilities
- Storage Facilities
  - Storage Buildings

In conclusion, analysis of the more recent ASMIS data indicates that materiel handling accidents are on the decline. Military materiel handling accidents decreased significantly during the period FY 1987-1988 compared to FY 1983-1986. However, the number of accidents, injuries, days lost, and

total costs show that further reductions are possible and that changes are required in current materiel handling methods. These analyses were summations of specific materiel handling areas, i.e., Occupation, MACOM, Location, etc., and the results should not be used as indicators of the more hazardous materiel handling Occupations, MACOM, Locations, etc. Exposure data and/or manpower estimates would be required to establish accident rates that could be used to identify the more hazardous materiel handling areas. However, this data may be difficult to collect based on the large numbers of MOSs and civilian worker families involved in materiel handling.

4.2 DISCUSSION OF DA FORM 285-1 ACCIDENT DATA ANALYSES

There were 165 DA Form 285-1 accident reports submitted to the USASC. Of these, 15 were determined to be either not materiel handling or insufficient information was provided to determine the cause of the accident. Of the remaining 150 accidents, 144 were due to human errors, 4 were due to materiel failures and 2 were due to the environment. The following discusses the results of the analysis of the DA Form 285-1 accident data.

The majority of the accidents involved individuals handling excessive loads or using improper techniques. These two problem areas accounted for 72 percent of all materiel handling accidents analyzed. Individual or teams of individuals handling excessive loads accounted for 43 percent of the transportation accidents and using improper techniques accounted for 43 percent of the transportation accidents. Individuals or teams handling excessive loads accounted for 32 percent of the loading or unloading accidents and the use of improper techniques accounted for 27 percent.

The system inadequacies most often identified as the causes of human errors during "Transportation" activities are: 1) overconfidence (44 percent); 2) inadequate attention (32 percent) and 3) inadequate motivation (26 percent). The top three system inadequacies identified for "Loading or Unloading" activities are: 1) overconfidence (86 percent); 2) inadequate motivation (45 percent) and 3) inadequate attention (36 percent). The system inadequacy most often identified in the "Other Materiel Handlers" category is inadequate attention (50 percent). Each of these system inadequacies will be addressed in the following paragraphs.

Overconfidence: Overconfidence is individual specific, that is, the individual overestimates his or her capabilities and can potentially injure themselves or others when moving materiel. A person's overconfidence in their abilities is difficult to control by the Army system. However, based on the numbers and costs associated with materiel handling, this is an area that should be addressed in future Army safety studies.

One possible avenue to correct this situation is performing medical tests to determine the capabilities of an individual prior to handling materiels. This type of testing, described in "Work Practices Guide For Manual Lifting," was prepared by NIOSH to assist in reducing the numbers of overexertion accidents that occur each year in industry. Using this method,

each individual identified for a materiel handling task would be pre-tested and assigned to specific areas where the potential for exceeding his or her capabilities would be greatly reduced. This will also improve efficiency, safety and increase the available resources by using the most appropriate individual for a task.

Inadequate Attention: Inadequate attention is another problem that would be difficult to control. This was most often identified in situations where the individual did not consider the weight or size of an item and injured themselves.

This system inadequacy could be corrected in a similar manner as overconfidence. That is, assign the most appropriate individual to a task or a work location and the consequences of an individual misjudging the weight or size of a package would be minimized.

Inadequate Motivation: Inadequate motivation or acting hastily was identified as a cause of materiel handling accidents because the person acted hastily and did not address the task properly. That is, the materiel handler acted hastily and did seek assistance, either mechanical or additional personnel, or the materiel handler ignored the potential hazards of the materiel being handled or the use of improper techniques. Inadequate motivation is best controlled by supervisors clearly communicating their expectations regarding safe performance of work tasks and enforcing established safety procedures. Where workers don't follow safety procedures, supervisors must determine what factors motivate.

To control inadequate motivation, supervisors must communicate their expectations regarding safe work performance and enforce established safety procedures. Where problems arise, supervisors need to determine the factors that motivate workers to acti in an unsafe manner, e.g., act hastily. Supervisors need to routinely observe work practices and be open to discuss problem areas.

Overconfidence and inadequate attention, along with the other system inadequacies that together constitute "inadequate self-discipline," accounted for 60 percent of the total system inadequacies. This compares with 38 percent of the system inadequacies found in combat vehicle accidents during field training exercises, and 46 percent of those for new vehicle accidents. This consistently high percentage of inadequate self-discipline has led to the USASC specifically addressing, as apart of the Army Safety Studies Program, indicators for identifying people prone to inadequate self-discipline, and the development of a motivational system to reduce inadequate self-discipline.

An additional analysis was performed to evaluate whether the detailed analysis of problem areas (which utilized data from DA From 285-1) was truly representative of all materiel handling accidents. This involved selecting the same number of accident reports for each year from the ASMIS database as were used in the original analysis. The result of this analysis indicated

that the problem areas identified in the DA Form 285-1 were representative of all materiel handling accidents contained in the ASMIS database. With the exception of the problem area "Trips, Slips or Falls" and individuals lifting "Excessive Loads" the percentages of accidents selected from the ASMIS database and the targetted accidents reported on the DA Form 285-1 varied by one to three percentage points.

In conclusion, the analysis of the DA Form 285-1 data and the additional analyses performed using the ASMIS database indicate that the majority of the materiel handling accidents occur to civilians or approximately 70 percent of the all materiel handling accidents for the four-year period. Over 50 percent of the civilian accidents were identified in the "Transportation" category. This is an area that should be investigated routinely and brought to the attention of the civilian employers. In industry, active materiel handling training programs have been proposed by DuPont Safety Services with an estimated reduction of 37 percent for a five-year period, in the numbers of accidents for all activities. A 37 percent reduction in the numbers of materiel handling accidents to civilians would represent reductions of 2,300 accidents, 23,164 days lost, and $3,218,360 injury costs over a four-period comparable to that analyzed here.

4.3 FIELD VERIFICATION DISCUSSION AND CONCLUSIONS

The field verification study reinforced the problem areas and system inadequacies noted in the accident analysis. The priorities military and civilian workers expressed concerning problem areas and system inadequacies did not coincide with the frequency with which these factors were identified in the analysis of accident reports.

Improper technique was identified as the principle materiel handling problem area by military and civilian respondents; both by the frequency with which it was cited as a problem area (32%) and by the frequency with which it was listed as the number one problem area (30%). For comparison, improper technique was identified as a causative factor in 33 percent of the FY 86 285-1 materiel handling accident reports (See Table 3.3).

The availability and adequacy of materiel handling equipment was identified most frequently (39.6%) as being a moderate or serious problem. On a scale from 1 "not a problem" to 4 "a serious problem," this system inadequacy received an average rating of 3.09 from military respondents and 1.96 from civilian respondents for an overall average of 2.21. This was the worst rating given to any system inadequacy and appears to be due in part to an inability to provide scheduled preventive maintenance as required. This system inadequacy was directly related to only about 5 percent of the FY 86 materiel handling accidents including the "materiel failure" and "equipment usage" categories of Table 3.3. When appropriate materiel handling equipment is not available, either because of budgets or maintenance problems, workers must use other means to accomplish materiel handling tasks.

The second worst system inadequacy was insufficient personnel. It was identified in 30.7 percent of the questionnaires as being a moderate or serious problem with an average rating of 2.91 from military respondents and 1.85 from civilian respondents for an overall average rating of 2.08. If there is inadequate materiel handling equipment, then more materiels must be handled manually which increases the risk of injuries. Without sufficient personnel to safely do the work, the number of lift cycles per hour and the average load must increase in order to meet work demands.

Considering these top two system inadequacies together with the fact that the second leading problem area identified by workers, "congested work areas," is also a system inadequacy, we can see that the workers themselves see the underlying problems that lead to materiel handling accidents are related to facilities, equipment and manpower. To some extent, these system inadequacies reflect infrastructure and modernization issues that the Army is facing. The specific observations from the field study noted in Section 3.13 regarding facilities, equipment and personnel tend to reinforce this premise.

Personal factors such as inattention and overconfidence were identified as the most frequent system inadequacy in the analysis of FY 86 accident reports. However, this system inadequacy was identified as being a moderate or serious problem area in only 11.9 percent of the questionnaires. Since the field study included both first line supervisors and workers, it is unlikely that supervisors would have failed to identify personal factors as a significant problem area if it existed. Of the 22 supervisors that completed questionnaires for the field verification study, only 4 (18.2%) indicated that personal factors such as inattention or overconfidence were a moderate or serious problem. All four of these were military supervisors and only one supervisor identified personal factors as a serious problem. The discrepancy between the accident report data and input from the field verification survey may be due in part to a difference in scope, because the accident reports dealt only with personnel involved in serious accidents while supervisors considered all their employees. A second possibility is that guidance for accident investigation has a built-in bias that leads investigators to conclude that most accidents are due to human error.

Picking one error from a limited list on the DA Form 285 often requires some force fitting. In addition, there may be a subconscious or conscious motivation to cite personal factors such as overconfidence, inattention, inadquate motivation or inadequate composure since such mental states preclude further action. One is struck by the impossibility of an accident investigator being able to accurately determine such mental states. Such factors lead to such incongruous accident causal statements as the soldier who ruptured an armal tube in his car due to overconfidence in his abilities. During the field verification study, one group of employees indicated that if an accident occurred, the employee was assumed to be at fault.

This study shows that the materiel handling problem is primarily a manual materiel handling problem which in turn is primarily a problem of back

injuries. Table 3.17 shows that Army civilians had over twice (2.25) the materiel handling accident incidence rate as military personnel during the period FY 1983-1986.

All personnel in Army must be considered materiel handlers based on the distribution of materiel handling accidents. It is not surprising that materiel handling accidents are the second largest cause of personnel injury accidents in the Army. By definition, if you ever handle materiel, you are a materiel handler. Materiel handling does not mean someone who is trained specifically for that function. On the other hand, forklift operators who may be trained and licensed to handle materiel may be involved in materiel handling accidents which are classified as "operating a motorized vehicle," even though the operation conducted involved a materiel handling task. This has resulted in only two forklift accidents being classified in the materiel handling category during the four year period FY 1983-1986.

The Army needs to ensure that official materiel handling guidance is consistent with research findings and made available at the installation level. The National Institute of Occupational Safety and Health (NIOSH 1990) will be releasing an updated version of its Work Practices Guide for Manual Lifting in January 1990. This work will provide an excellent text for installation safety and health personnel and provides an appropriate technical basis for updating existing guidance. The "Physical Stress Job Analysis" procedure and criteria provides a methodology for objectively evaluating existing or proposed lifting tasks. This method should be adopted for evaluation such tasks when they appear to be excessively strenuous or are known to have caused injuries in the past. Attention should be focused initially on those MOSs and civilian worker families having the highest materiel handling injury incidence rates to determine that routine tasks do not exceed the maximum permissible load limits as defined by NIOSH.

The risk of materiel handling accidents cannot be separated from the design of facilities and Army systems. Where facility layout and installed materiel handling equipment was poorly designed, there were many potential materiel handling hazards noted during the field verification study. Flow-though layout of shipping and receiving facilities and provision of designated pedestrian aisleways in warehouses and maintenance areas are but two examples that must be considered. Proper design can also eliminate many of the environmental hazards noted in the field survey. Army systems such as the Abrams M-1 tank have considered the safety of maintenance operations and have used modular design and provided special maintenance stands which facilitate materiel handling. Army design guidance related to lifting requirements should be compared with the NIOSH guidelines noted above. New facility designs should evaluate lifting tasks at proposed work areas using the NIOSH procedure to determine when mechanized materiel handling equipment is necessary to reduce the risk of injury.

Heavy workloads lower morale and motivate workers to look for shortcuts which may increase risks. Proper management planning can reduce the workload swings caused by poor scheduling. Supervisors must actively promote open

communication with their workers and seek feedback on problems that are being resolved. Workers and first line management should be encouraged to identify locations where special fixtures and devices can be used to reduce material handling risks and increase efficiency.

There were instances noted in the field survey where the addition of specific equipment would have reduced the potential for injury associated with a materiel handling operation. There were other locations where the equipment available was not appropriate for the operation such as unloading commercial trucks using military 6000 pound forklifts rather than the smaller 4000 pound commercial forklifts which are more maneuverable inside the trailer. Although opportunities may be limited, there were some locations where materiel handling equipment seemed to be sitting idle or was inoperable. Such equipment should be made available to other organizations.

Two programs related to this materiel handling study were identified. The first is the "Army Back Complaint Program"[a] which is an integrated approach to reduce back complaints within the Army. The information cited in this program states that a quarter of all Office of Workers' Compensation cases and a third of all costs are the result of back complaints. No evidence of the use of this program was noted during the field verification study. The second is an ongoing effort by HSC to develop protocols to ensure that soldiers with uncomplicated back injuries either have recovered or are separated from the Army within six months. When researchers at HSC's Health Care Studies and Investigation office pulled files from 100 recent boards, they found that 25 cases involved back injuries. The costs cited in this study (McFarling 1989) include materiel handling property damage and injury costs only; it does not include military or civilian disability compensation costs for such injuries. These costs are divided among the Office of Workmen's Compensation, the Army and the Veteran's Administration and are not easily assessed. However, if a quarter to a third of all compensation costs are related to back injuries, the total compensation costs for all materiel handling accidents is staggering and overshadows the initial accident costs cited in this report.

Each year, congress establishes a fixed personnel authorization for the Army. Soldiers in holding status reduce overall military readiness by tying up limited positions. In FY 1988, TRADOC had a 5.2% holdover rate which resulted in 750,000 days or 2000 soldier years lost. There are a variety of reasons for placing soldiers in holdover during basic or Advanced Individual Training (AIT) including medical reasons. No information was available from TRADOC Headquarters regarding the percentage of these lost days that were due to injuries. Until the impact of materiel handling injuries on training or overall readiness of the Army can be reported in terms of cost and manpower lost, Army decision makers will not have the basis to make the necessary

(a) Mitchner, M.E., R. J. Sumser, and J. H. Rumbaugh. May 13, 1986. Letter and Information Packet to Army Installation Commanders, "Army Back Complaint Program."

management decisions. If the USASC wants to declare a war on materiel handling accidents, it first must characterize the full extent of the threat. This study provides part of that characterization, but additional work will be required.

While Federal Personnel regulations direct the Army to do everything possible to retain civilian workers who have become disabled during their career, Army physical standards eliminate soldiers with disabilities incurred during their career. There appears to be a need to examine the impact of such policies to ensure that the benefits are commensurate with the costs incurred. For the civilian case, the extreme policy may place workers back into jobs into which they are at risk of further injury. For the military case, the Army may be incurring high costs of recruiting and training replacements for those soldiers who are boarded out of the Army with relatively minor disabilities.

During a followup discussion on the compensation costs associated with back injuries, an Army physician mentioned that China has no back injury problem. This sparked a discussion of the reason that this might be true. The apparent answer was that while the Chinese workers probably suffer back injuries at similar rates, that they, like many self-employed American farmers, just recover on the job. It was suggested that countries such as the United States and Australia that have experienced high accident disability rates may have more liberal provisions in their compensation laws. This hypothesis needs to be investigated to determine whether it "pays" to be disabled. The provisions of compensation programs in countries that do not seem to have high disability rates should be compared to those in the United States to determine where there may be significant differences.

The physical therapist at one installation visited was in the process of purchasing a special piece of equipment used to measure range of motion, body forces and torques and to provide a record of this information for physical rehabilitation purposes. This individual indicated that local rehabilitation centers had demonstrated that such equipment could be successfully used for "work hardening" to accelerate an injured employee's return to work. A physician at William Beaumont Medical Center who is using such equipment to treat knee injuries indicated that he felt that with the proper back attachment, that this type of equipment might be useful as a means to objectively screen prospective candidates for lifting jobs or to assess the degree to which an injury is disabling. He indicated that such use would require investigation since he had seen no literature that would validate use of such equipment for this purpose.

Job descriptions typically speak of maximum loads which are handled. From a biomechanics standpoint, this is meaningless unless the location of the load center of gravity, the beginning and ending point of the lift and the size of the load are also known. Persons lifting loads need to be aware that safe lifting requires that an individual consider more than just the weight of the item to be lifted. Workers questioned seemed satisfied when items had the weight marked on the container.

There are many organizations that have an interest in reducing materiel handling injuries. The responsibilities for reducing the frequency and severity of materiel handling accidents overlap in many areas and it takes a coordinated approach at Army management levels and at the local level to provide an effective program. There is much that could be gained by a focused exchange of information between interested organizations.

Accident prevention training programs for manual and mechanized materiel handling should be developed and opportunities presented to installation management and personnel who will have a role in training installation workers. Commercial training programs that have a proven record of success should be examined for application to the Army's needs. Materiel handling training programs should be tested at selected installations prior to adoption. The Army Back Complaint Program resulted from a coordinated effort and promotes a coordinated effort at the installation level. While this program contains back injury prevention materials, the connotation of this program is that it deals with injured personnel after the fact rather than dealing with hazardous situations before an injury occurs. The effectiveness of this program should be compared with commercial training programs to determine ways in which the best of both programs can be combined. Training like task analysis should target MOSs and worker families with high materiel handling incidence rates.

There are three points that should be made regarding analysis of accident data. Incidence rates should be used when developing accident reduction strategies rather than frequencies to target groups with the highest risk. Use of a single activity category to classify accident reports restricts access to relevant accident data for research purposes. It appears that forklift accidents were not classified as materiel handling accidents, even though the primary purpose of the forklift is materiel handling. The use of multiple activity categories should be considered. Analyses where all accident data for a period must be divided to show the distribution among categories could use a primary activity category only. Finally, it is apparent from observing field operations that division of materiel handling tasks into the three categories of transporting, moving or delivering; loading and unloading; and other tasks (e.g. securing loads, packing, rigging, and palletizing) is not a highly useful division since the tasks are not independent. Palletizing involves moving loads and may be considered as a loading operation in some locations. Loading requires that loads be transported by forklift and secured.

5.0 RECOMMENDATIONS TO REDUCE MATERIEL HANDLING ACCIDENTS

This section provides recommendations to reduce the frequency and severity of Army materiel handling accidents. These recommendations are based both on the analysis of accident data and input from the field. The organizations having primary responsibility for implementing each recommendation are listed in parentheses following the recommendation. While the USASC will have primary oversight responsibility for ensuring that recommendations are implemented, the direct responsibility will rest with the Commanders of the MACOMs and installations affected. Safety programs must be require line management commitment and accountability in the same way that any other mission essential activity requires line management attention.

- Conduct research into use of physical therapy machines, that measure and record body forces, torques and range of motion, as medical screening tools for preemployment physicals for lifting jobs and in medical examinations of back injuries. Develop a lifting profile to match the worker to the demands of the job if use of such equipment for medical screening is feasible. (HSC/William Beaumont Army Medical Center)

- Adopt the NIOSH Physical Stress Job Analysis procedure and criteria for evaluating lifting tasks and job lift requirements. Revise job descriptions to include this method of describing lifting requirements of the job, beginning with the highest risk occupations first. Evaluate new or revised work place designs using this method. (USASC/HSC/DCSPER/COE/Installations)

- The Army personnel that DoD adopt the guidance in the NIOSH Work Practices Guide for Manual Lifting to replace lifting guidance contained in DODI 4145.19-R-1 "Storage and Materiel Handling" and revise or replace DA Pamphlet 385-8, "Safety Back Injury Prevention" and provide this guidance to installation safety and medical organizations. (USASC/HSC)

- Develop or adopt a commercial manual material handling training program that reflects current manual lifting research. The training program should be tested at several installations to be able to measure its effectiveness in preventing lifting injuries, prior to making it available to all Army installations. Ensure that management's role is included in such training and that managers understand the Army's commitment to reducing material handling accidents. (HSC/USASC)

- Encourage the development of special fixtures and devices that increase efficiency and reduce manual materiel handling. Encourage the dissemination of information on such equipment through safety and technical channels. (USASC/MACOMS/Installations)

- Increase the availability of mechanical materiel handling equipment through purchase and relocation, and ensure that preventive maintenance for such equipment is performed on a routine basis. (MACOMS and Installations)

- Provide increased review of new and existing facilities to facilitate mechanized materiel handling and reduce the demands for manual handling through proper layout and design. Facility layout should provide for separation of pedestrian and mechanized traffic. (MACOMs/Army Installations/COE)

- Ensure that high traffic materiel handling areas provide adequate traction and are covered to minimize environmental effects. Continuous housekeeping in such areas must be enforced. (MACOMs/Army Installations/COE)

- Review the design guidelines on lifting limits in MIL-STD-1472 and lifting capacities in MIL-HDBK-759 in light of recent research referenced in the NIOSH Work Practices Guide for Manual Lifting and revise as necessary. Consider using the NIOSH Physical Stress Job Analysis method to analyze lifting tasks for new Army systems or modifications of existing systems. (MICOM)

- Ensure that Army acquisition programs require development of special materiel handling devices and equipment where maintenance tasks involve movement of components that exceed NIOSH maximum acceptable lift limits which cannot be handled by mechanical lifting devices typically found in maintenance facilities. (DCSRDA, PEOs and PMs)

- Encourage managers to monitor planning and scheduling of material handling operations to ensure that sufficient time and resources are provided for the work required. Look for evidence of unsafe work practices which may be due to schedule constraints or poor planning. (Army Installations)

- Encourage input from workers regarding safety of materiel handling operations. Ensure that workers' questions and suggestions are taken seriously and that a clear response is provided. (Army Installations)

- Provide incentives for injury prevention by adopting a compensation costing system that rewards installations with low compensation costs and penalizes installations with high compensation costs. (DCSPER/USASC)

- Initiate a review of the OWCP, DA, and VA compensation programs to evaluate the degree to which these programs provide a "disability incentive." If it "pays" to be disabled, look for evidence of abuse of these compensation programs. This study should also review literature on compensation programs in other countries to determine the extent to which the provisions in their programs seem to have an impact on their back injury claims. Provide results of this study with recommendations to the responsible agencies and congress if warranted. (DCSPER/HSC/USASC)

- Recommend an annual report of the cost of Army military and civilian disabilities be established to highlight the financial impact of material handling injuries. (DCSPER/USASC)

- Since back injuries are the leading type of material handling injuries, USASC should sponsor a conference on back problems associated with manual materiel handling. This conference should seek to determine the programmatic impact of such injuries in terms of degradation of readiness, training effectiveness, etc. One objective of this conference would be to bring experts from interested organizations together to examine this problem from various perspectives. A second objective is the need to focus attention on all aspects of the back injury problem in order to develop an integrated strategy for reducing the frequency and severity of back injuries and their impact on the Army. This conference could explore ways that the recommendations of this report might best be implemented. (USASC)

- In setting priorities for reduction of materiel handling injuries, use accident incidence rates rather than accident frequencies. (USASC/MACOMs/Installations)

- Permit and encourage the use of multiple activity categories in the ASMIS database to ensure that searches for relevant accident data are reasonably complete. For example, forklift accidents could be classified in both the "motorized vehicle" and "materiel handling" activity categories. (USASC)

These recommendations encompass a comprehensive materiel handling safety program. While various parts of a comprehensive program were found operating at the installations in the field study, their was little consistency between installation programs. There is too much at stake to leave the materiel handling safety program to chance. The Army needs to integrate responsible organizations and develop an integrated strategy for implementing these commendations. This is especially true of the recommendations that demand action and coordination at higher levels.

The payoff for instituting materiel handling accidents is not just the reduction in the direct loss time costs estimated in this report. It will have a greater impact in its reduction of compensation costs and increase in the Army's overall readiness.

6.0 REFERENCES

McFarling, D. 1989. Low Back Pain: A Practical Approach to Management. Consultation Report # 89-001. U.S. Army Health Care Studies and Clinical Investigation Activity, San Antonio, Texas.

National Institute for Occupational Safety and Health. 1981 (Revised edition January 1990). Work Practices Guide for Manual Lifting (81-122).

Military Documents

DODI 4145.19-R-1. September 15, 1979. Storage and Materials Handling.

DA Pamphlet 385-8. June 1985. Safety Back Injury Prevention.

MIL-STD-1472C. May 1981, with Notice 3, March 1987. Military Standard Human Engineering Design Criteria for Military Systems, Equipment and Facilities.

MIL-HDBK-759. March 12, 1975. Military Standardization Handbook, Human Factors Engineering Design for Army Materiel.

APPENDIX A

MATERIEL HANDLING QUESTIONNAIRE USED IN THE FIELD VERIFICATION STUDY

PART 1 Description of Materiel Handling Work Activities

Thinking about the past fiscal year, please estimate the percentage of your time that you normally spend on each of the following categories of materiel handling work activities.

1. Transporting, moving or delivering _____%
All movement of materiels except those by normal highway vehicles.
2. Loading and Unloading _____%
Unloading of shipments, stocking shelves, loading vehicles, etc.
3. Securing loads, packing, rigging, palletizing, etc. _____%
Preparation of materiels, parts, equipment for transport or handling.

Are you primarily responsible for materiel handling activites?
☐ No ☐ Yes

PART 1B Materiel Handling Equipment Used

Estimate the percentage of your materiel handling time that you used each type of equipment listed below.

1. Manual materiel handling (Non-mechanical)	_____%
2. Hand trucks, pallet jacks or dollies	_____%
3. Forklifts or other industrial trucks	_____%
4. Hoists or Cranes	_____%
5. Conveyors	_____%
6. Other_____	_____%
Total	**100%**

PART 1C Materiel Handling Procedures

Identify the sources of materiel handling procedures that you follow by number, title or brief description.

☐ SOP _____
☐ Installation Regulation_____
☐ Army Regulation_____
☐ DOD Guidance_____
☐ Verbal Instructions Only_____

PART 1D Loads Handled

List the most common types of loads that you handle with their approximate weight and size starting with the heaviest load. Also estimate how often you handle the load described and the type of materiel handling equipment used by number from 1B. List a range of weights or sizes if necessary to describe the load. For example, boxes, 5-20 lbs, 12"x12"x12"-24"x16"x16", 40/wk., 2.

Materiel Handled	Weight	Size	Items/week	MHE
1.				
2.				
3.				
4.				
5.				

PART 2 Identification of Materiel Handling Problem Areas

Problem areas are defined as situations that can lead to accidents. When driving for example, following too closely can lead to rear end collisions. Think about the problems associated with materiel handling activities and list those problems below from the most serious to the least serious.

1._____
2._____
3._____
4._____
5._____
6._____
7._____

Please go the the next page. ☞

PART 3 Comments on Materiel Handling Activities

Below is a list of some problems that sometimes affect the safe accomplishment of materiel handling activities. For each item, please indicate whether you feel it is: ***not a problem, a slight problem, a moderate problem, or a serious problem in*** *accomplishing your materiel handling activities.*

		Not a Problem	Slight Problem	Moderate Problem	Serious Problem
A	Lack of written procedures or procedures do not include adequate safety guidance	1	2	3	4
B	Lack of appropriate training and skills	1	2	3	4
C	Not enough personnel to do the work	1	2	3	4
D	Materiel handling equipment is inadequate or unavailable	1	2	3	4
E	Inadequate supervision	1	2	3	4
F	Personal factors such as inattention or overconfidence.	1	2	3	4
G	Other responsibilities make too many demands on my time	1	2	3	4
H	Lack of Motivation	1	2	3	4
I	Inexperience	1	2	3	4
J	Other_____	1	2	3	4

PART 4 Some Additional Questions

We would like to ask you a few questions to help us interpret the results. Is your position: A☐ Supervisory *or* B☐ Non-supervisory

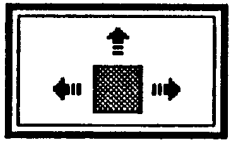
A☐ Civilian
➥ Please indicate your grade level: _____ job series:_____
B☐ Military
➥Please indicate your current rank: _____ MOS:_____

Do you have any additional comments? _____

_____

_____

Thank you for your help!



USASC Materiel Handling Accident Study

Field Survey of Materiel Handling Activities and Personnel

Each year the U.S. Army experiences over 2000 lost time injury and property loss accidents. For the four year period FY 1983 to 1986, over 9000 materiel handling accidents occurred with a total of almost 100,000 lost workdays and a total direct cost of almost 19 million dollars for injuries and property damage (This excluded motor vehicle accidents involving materiel transport by conventional motor vehicles).

As part of its overall accident prevention mission, the U.S. Army Safety Center is conducting a study of materiel handling accidents in order to develop realistic and effective countermeasures to reduce the incidence and severity of materiel handling accidents.

The purpose of this survey and field observation is to compare the problems identified through review of accident reports with those problems identified by the people who perform the materiel handling tasks and through observation of the workplace and materiel handling tasks. We need your participation in this survey to accurately characterize and assess the materiel handling problems that can lead to accidents.

This survey asks you about the kind of work you do and the problems that affect the safety of the materiel handling activities you perform. Filling out the survey should take you about 15-20 minutes.

The information you provide on this survey is considered confidential. Pacific Northwest Laboratory (PNL) will prepare the data and analyze the results.

Please go the the next page. ☞

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